THE PEDAGOGICAL SEMINARY AND

JOURNAL OF GENETIC PSYCHOLOGY

Child Behavior, Animal Behavior, and Comparative Psychology

EDITED BY

CARL MURCHISON

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VOLUME 55

1939

Published quarterly by The Journal Press
Provincetown, Massachusetts, U. S. A.

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The Journal of Psychology

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Carl Murchison

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[illegible] will be adjusted [illegible]

(3). The accumulated units will be mailed to subscribers quarterly: January, April, July, and October. The units may vary in [illegible]

[illegible]

THE JOURNAL [illegible]

[illegible]

$7 00 per volume
Single numbers $4 00

QUARTERLY
Two volumes per year

September, 1939
Volume 55, First Half

Founded by G Stanley Hall in 1891

THE PEDAGOGICAL SEMINARY AND JOURNAL OF GENETIC PSYCHOLOGY

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SEPTEMBER, 1939

(Manuscripts are printed in the order of final acceptance)

(OVER)

Entered as second-class matter, August 3, 1897, at the post-office at Worcester, Mass, under the act of March 3, 1879
Reentered as second-class matter May 11, 1937, at the post-office at Provincetown, Mass., under the Act of March 3, 1879

The Journal of Genetic Psychology, 1939, 55, 3-30

TYPICAL BEHAVIOR PATTERNS IN TWENTY-SIX ORDINAL POSITIONS*

Chicago City Junior Colleges

MAURICE H. KROUT

A THE EFFECT OF THE FAMILY MILIEU

Since the basic behavior patterns are acquired in the family, it is within the realm of expectancy that family members show similar behavior traits Freeman *et al* (1) have shown that children removed from parental homes acquire the patterns of intelligence prevailing in the foster homes They have thus proved that even intelligence is a function of social interaction in the family milieu, and changes when this milieu changes Hofteditz (2), and Newcomb and Svehla (3), dealing with similarities between parents and children, have obtained sizable correlation coefficients in proof of the assumption that the attitudes of children resemble those of parents. Thus, too, Finch (4) and Kulp and Davidson (5) have shown even more convincing correspondence between the attitudes of sibs, Kulp and Davidson concluding from their data that "the home is, in general respects, more potent in influencing social attitudes than is the school."

If these coefficients of resemblance prove that institutional patterns tend toward uniformity, they do not gainsay the long-known fact that two individuals do not react similarly to a given environment First of all, there are differences, in age and sex which cannot but affect responses in the family milieu Newcomb and Svehla (6) show that greater similarities exist between the attitudes of mothers and sons, or of fathers and daughters, than between those of mothers and daughters or those of fathers and sons They have also discovered consistent sex differences, due to intra-family relationships, and divergences in mean scores increasing with increasing age-levels.

Even if we could assume an hypothetical constancy in age and sex

*Received in the Editorial Offices on July 25, 1938

Read in part before the Midwestern Psychological Association, at Madison, April 22, 1938.

factors in the behavior of different members, we should still have to allow for the fact that siblings, interacting on each other, create an ever-changing milieu in the family In any case, no one can afford to overlook the fact, not always open to superficial observation, that reactions to the family environment vary with the amount of harmony between the parents and the degree to which each parent succeeds in projecting his or her tensions on the children chosen for this purpose No two children meet the unconscious needs of their parents in the same way or to the same extent The proximity of the favorite child to the problem-ridden parent cannot but affect the child's behavior in a way in which other children in the family are not affected The same in another sense is true of the rejected child

It is sometimes assumed that step-children and illegitimate children are rejected, and illegitimate children are unwanted Yet clinical psychologists know that child-neglect may be found in normally constituted families The same factors that contribute to favoritism are found to lie at the basis of rejection, varying from mere indifference to the infliction of traumata

In discussing favoritism and rejection we cannot lose sight of the fact that changes in the family constellation through the addition of new members may tend to relieve, as well as aggravate, the tensions created by certain types of parent-child responses The sibling is not a silent witness of a drama in which the parents and another child participates. Siblings do affect each other, and the way in which they do so indirectly reflects on the parent-child relationship as well

B The Role of the Sibling

Over twenty years ago Freud (7) remarked that the resolution of the "family romance" may be found in the transfer of parent-fixated affection to a sibling of the same sex as the parent's. The writer has chosen to designate this phenomenon as the *deflection of the parent child conflict.* The ordinal succession does not make the deflection compulsory, but it does provide an opportunity for it. The influence of the parents still continues, but it is no longer the same sort of influence For overindulged or rejected children the deflection of the conflict may be so much more necessary, but perhaps so much more difficult also, for the transfer of affections comes about normally in families in which the parent-child conflict had not been

intensified by complicating factors. The age at which the parental fixation had taken place, the age-interval between the sibs, the sex of the older or the younger sib, the gradualness or suddenness of weaning of the older sib, the favoritism or rejection of the older or the younger sib—all these may be complicating factors determining whether or not, and how adequately, a deflection of the parent-child conflict can be brought about

If it is possible to obtain substitute love-expression in the family milieu, it is also possible to obtain substitute expression for the hate-impulses which grow out of the "family romance" What the Freudians have called the "Cain complex" is a behavior-pattern which provides an outlet for aggression-impulses originally directed by the child to the parent of his or her own sex This pattern, as recently described in an experimental monograph by Levy (8), is not the less real because of its subtlety Indeed, it is in such subtle *interplay of influences between parents and children*, on the one hand, and between the children themselves, that we find some of the most intense emotional behavior of which human beings are capable *It is this behavior of family-members that explains how the personalities of human individuals are molded and remolded, stimulated and stunted, sublimated and perverted*

C. Previous Studies of Birth Order

Behavior differences based on ordinal position in the family seem to have intrigued many investigators Mitchell (9), who in 1866 was among the first to deal with the problem of birth order, established to his own satisfaction that idiots are first-born Galton (10) in 1874, proved to his satisfaction that geniuses are first-born Since then hundreds of research papers have appeared in print, and many others never probably have reached the printing stage. In view of the fact that Jones (11), seven years ago, and Murphy, Murphy, and Newcomb (12), last year, published excellent summaries of the literature on birth-order, we shall forego the necessity of proving that virtually every problem of socio-psychological importance has been studied from that point of view Suffice it to say that within a period of 70 years, we have had publications on the relation of birth order to (*a*) genius and feeble-mindedness, (*b*) suggestibility and aggressiveness, (*c*) dominance-feeling and sensitivity to pain, (*d*) sociability and ascendancy, (*e*) religious attitudes and political atti-

tudes, (*f*) emotionality and stability, (*g*) neurotic make-up and psychotic trend, (*h*) happiness and jealousy, (*i*) school failure and fame.

As one wades through this literature, one finds an enormous mass of assertions and counter-assertions. Virtually every study establishing some point with regard to birth order has been replaced by a later study proving the possibility of an opposite point in the same connection. Furthermore, of late the literature has been flooded with studies attempting to show that birth order, as a factor in behavior, is of *no* importance. Thus Jones and Hsiao (13), Smith (14), Baker, Decker, and Hill (15), Thurstone and Jenkins (16), and the Thurstones (17), have committed themselves largely to the negative point of view. In addition to these, most recently, Stagner and Katzoft (18), Witty (19), and Wile and Jones (20), have offered essentially negative data. Little wonder, then, that Murphy, Murphy, and Newcomb (21), after examining the output, reach the conclusion that the attempt to explain behavior in terms of non-psychological factors such as birth order is thoroughly futile. It is hardly conceivable, nevertheless, that all this effort should have been for naught. Indeed, it is probable that, from this mass of evidence and counter-evidence, claim and denial, we may salvage a few sterling contributions to technique, if not to theory, which may be of aid in the further prosecution of the subject.

D. Helpful Contributions of Previous Studies

In one of the most careful studies of birth order, Jones (22) has told us that this term *birth order* refers alike to (*a*) living children, (*b*) social relations between sibs, and (*c*) pregnancy order. Following this lead, Hsiao (23) has actually proved that 15 per cent of those identified as first-born are second in pregnancy order, and an equal per cent of second children are third in this respect.

It did not occur to investigators for a long time that the tests used in the study of birth order might have been defective or wrongly applied, or that wrong statistical techniques might have been used to organize material obtained. Thus Jones and Hsiao (24) have shown that there is a negative correlation between *IQ* and age of entering school, which changed the reliability of intelligence measures quite independently of the effect of birth order. By translating test-scores into standard scores they eschewed this particular

error, and corrected spurious *IQ* fluctuations based on chronological age Similarly, a cumulative retardation in school achievement favoring later-born children was found to have a significant effect on comparative studies of achievement as related to birth order

Most studies have assumed, or at least tried to establish, some hereditary difference between sibs, explainable in terms of birth order The very use of the term *birth order* would suggest this implication In fact, on the basis of such an assumption, Pearson (25) advocated that families be limited to two offspring To those, of course, who have found genetic factors largely of importance in the study of structure, and have relied on environmental factors for the study of behavior trends, this problem hardly suggests itself Yet one of Pearson's persuasion would be interested in the announcement that Blatz (26) has found the Dionne quintuplets distinctly different personalities What explanation for such diversity of behavior tendencies could be devised from the genetic point of view?

In the vast majority of studies dealing with birth order the sex of the child strangely enough is either left unnoticed, or else is treated as a matter of casual concern. Whatever may be the current attitude in regard to human differences, certain it is that socio-psychological differences ought to be at least hypothetically assumed to be worth investigating Some inklings along this line are to be gained from scattered references in the literature Busemann (27) found several consistent differences in sexually homogeneous sibships. He found scholarship, for example, to decrease as the number of opposite-sexed siblings increased. Jones (28) questioned the importance of this finding, but neither Busemann nor Jones offered any explanation for it Thurstone and Jenkins (29) have stated that "there is some evidence that an alternation in the sex of siblings is most favorable to their behavior adjustments." Cullinan (30), in spite of her otherwise negative findings, has also reported that she found "age and sex differences in mean scores between the various sub-groups," on personality tests

Other factors found to have a definite relation to the problem are (*a*) size of family, which Stagner and Katzoff (31), for example, reported to influence personality test-scores, (*b*) progressive improvement or lowering of economic status with increasing births, found to be important by Thurstone and Jenkins (32), (*c*) length of birth-intervals, shown by the same authors (32) to determine

degree of intelligent behavior, and (*d*) a variety of physiological and social variables, such as parents' ages, mortality rate, incidence of disease, duration of labor, premature birth, weight-loss after birth, and duration of breast-feeding, all of them emphasized by Jones (33) and ingeniously controlled by Smith (34)

As seen in retrospect, then, after many years' effort, the problem reveals several errors of omission and commission In emphasizing biogenetic variables, and treating birth-order as a biologic fact, students of behavior overlooked epigenetic factors which, as the immediate factors in social relations, deserve first consideration In using semi-standardized tests, they made the outcome of their own studies hinge on the usability and accuracy of the tests employed In often disregarding family size, birth-intervals, and economic status, they left out factors whose importance now seems beyond dispute. In limiting themselves to three or four possible positions (the only, the oldest, the youngest, and the middle child), they obtained an amount of overlap which could not but vitiate their findings Finally, they made virtually no allowances for the sex of the subject and no allowances at all for the sex of the sibling preceding and/or following.

E. Standards and Techniques

In the classification of types employed in this investigation the term *ordinal position* was used instead of the older term *birth order*, to emphasize psychological position in the family, resulting from certain types of social constellations. Instead of tests, we have used a schedule calling for verbal responses based on the subjects' particular experiences as family members By confining the data to the lower middle—and working class—groups, whose economic status fluctuates little, if at all, we took account of economic variables which might be said to enter into differences attributed to ordinal position Birth-intervals were taken into account wherever they seemed to be interpretable in the light of some known socio-psychological principle Family size, the sex of the subject, and the sex of the siblings preceding and/or following, constitute the essence of our classification This includes 26 ordinal positions, thirteen for each sex (20). On the basis of the sexes of the siblings preceding and/or following, these may be grouped into (*a*) two onlys, (*b*) eight older or younger, (*c*) eight oldest or youngest (more than two sibs), and (*d*) eight intermediates (Table 1)

TABLE 1

A CLASSIFICATION OF ORDINAL POSITIONS

	Male types
1	Only child male
2	Older of two males
3	Older male followed by female
4	Younger of two males
5	Younger male preceded by female
6	Oldest male followed by male
7	Oldest male followed by female
8	Youngest male preceded by female
9	Youngest male preceded by male
10	Male between two males
11	Male between two females
12	Male between female and male
13.	Male between male and female
	Female types
14	Only child female
15	Older of two females
16	Older female followed by male
17	Younger of two females
18	Younger female preceded by male
19	Oldest female followed by female
20	Oldest female followed by male
21	Youngest female preceded by female
22	Youngest female preceded by male
23	Female between two females
24	Female between two males
25	Female between male and female
26	Female between female and male

A total of 1,093 cases was used, 648 males and 445 females, giving a mean frequency of 50 for the male and 34 for the female group The age curve was skewed to the lower end of the distribution The modal age of the subjects was 19 The subjects belonged to 432 families and none of them was either orphaned or half-orphaned At least one of the subjects in each family was a college student cooperating in the collection of the data The students were allowed to take the forms home, and to fill them or have them filled by the members involved

The schedule contained a request for a list of all living and dead

family members of each subject. This list gave the parents' ages and dates of birth, and the siblings by sex, age, and date of birth. The next section contained a check-list of ordinal positions, though the positions were also checked on the family list. The section following contained 24 statements having reference to the relations within the home. Samples are, *"Mother especially influential in the home," "Often disciplined by father," "Especially attached to younger brother No. 1, 2, 3, 4, 5,"* and *"Generally dominates younger sister No. 1, 2, 3, 4, 5."* The fourth section contained eight statements referring to such attitudes as domination, attachment or submission involving males and females outside the family.

The schedule was explained and illustrated beforehand, and the criterion was set down that, to be checked correctly, each statement must be translated to refer to concrete observations or experiences, showing a trend in a certain direction. The subjects were urged to fill the spaces provided only after deliberate consideration. They were asked to leave blank spaces where they could not be certain of the answers. Several choices were allowed, provided that they were not mutually exclusive.

The major task of this study was to apply the classification of types devised by the author to the discovery of relationships between certain basic intra-familial response-patterns and certain attitudinal patterns as between men and women in extra-familial contacts. Specifically, we aimed to see whether the presence or absence of the patterns of domination, attachment, or submission with reference to men and women outside the family milieu might show some interdependence upon (*a*) paternal or maternal dominance within the home, (*b*) paternal or maternal favoritism or discipline in the treatment of the various ordinal types, and (*c*) especial attachment, domination, or submission in the relations of subjects and their sibs.

It became obvious rather early in the study that the data obtained through our schedule, not being measured absolutely for each position, in terms of a common unit, would have to be grouped into classes, and dealt with in terms of comparative per cent-frequencies. The tables thus obtained were analyzed in two ways. A series of graphs was drawn to show the distribution of each variable (home influence, domination of sibs, etc.) in relation to the 26 ordinal positions, and another series was prepared to show the general trend for all variables in relation to each ordinal position. Following

Pearson's reasoning on goodness of fit, we employed his chi-square technique to secure a coefficient of mean contingency by the relation $C=\sqrt{\frac{S-N}{N}}$, where C = coefficient of contingency, S = the sum of the squared independence values, and N = the number of items By this technique we compared the frequency of association actually found with the frequency that might be expected if the values were completely unrelated, i e, independent The coefficients of contingency obtained for several fourfold tables, as a general test, ran at or about 0 288 for the women and 0 362 for the men According to Guilford and others (36) coefficients of this type, ranging between 0 25 and 0 49, may be considered not merely adequate but good Nevertheless, the interpretations given here depend as much on case material, obtained for each of our ordinal types, as on statistical trends obtained through the schedule.

F Family Group Dominance

The first object of this study was to determine whether families can be characterized in terms of dominance-patterns traceable to one or more family members. On the basis of dominance-frequencies supplied by subjects in the various ordinal positions, we found it possible to distinguish between paternal and maternal family-dominance Guided by an arbitrary 10 per cent-difference between recorded frequencies, we found five *matriarchal* and two *patriarchal* family types Reducing the difference to an arbitrary five-per cent level, we increased the frequency of paternal families to eleven, and the number of maternal families to seven Similarly, counting ordinal positions in which the domination-frequency was either the same for both parents or else showed a difference of less than five per cent, we might speak of six *equalitarian* family types Of the ordinal positions in which the total filial domination-frequencies come within five per cent of being equal to those of either parent, we find 12 which might be designated as *shared-control* family types Finally, in ordinal positions in which the total combined frequencies of child domination exceed those of either of the parents, we have discovered at least four that might be called *paidocratic*, or child-controlled (Table 2)

The family-dominance concepts, as used in this study, appear to have certain limitations Based on verbal reports reflecting attitudes of individuals in various ordinal positions, they might indicate differ-

THE RELATION OF FAMILIAL TO EXTRA FAMILIAL ATTITUDES IN TWENTY SIX ORDINAL POSITIONS

		ONLY CHILD MALE	OLDER OF TWO MALES	OLDER MALE, FOLLOWED BY FEMALE	YOUNGER OF TWO MALES	YOUNGER MALE PRECEDED BY FEMALE	OLDEST MALE FOLLOWED BY MALE	OLDEST MALE FOLLOWED BY FEMALE	YOUNGEST MALE PRECEDED BY FEMALE	YOUNGEST MALE PRECEDED BY MALE	MALE BETWEEN TWO MALES	MALE BETWEEN TWO FEMALES	MALE BETWEEN FEMALE AND MALE	MALE BETWEEN MALE AND FEMALE	ONLY CHILD FEMALE	OLDER OF TWO FEMALES	OLDER FEMALE FOLLOWED BY MALE	YOUNGER OF TWO FEMALES	YOUNGER FEMALE PRECEDED BY MALE	OLDEST FEMALE FOLLOWED BY FEMALE	OLDEST FEMALE FOLLOWED BY MALE	[illegible]	YOUNGEST FEMALE PRECEDED BY MALE	FEMALE BETWEEN TWO FEMALES	FEMALE BETWEEN TWO MALES	[illegible]	[illegible]
TYPE FREQ[illegible]																								35	65	41	28
FAMIL DOMINANT *																								50	57	51	46
																								47	51	51	50
																								09	20	17	07
																								34	14	20	14
																								09	12	05	11
FAVORED BY																								37	42	39	43
																								37	19	44	61
																								25	25	32	18
																								16	20	29	25
																								56	31	32	21
DOMINATES **																								17	17	10	
																								30	29	30	18
	SISTER					10			15	27	14	11	01	29				12				20	21	09	14		11
	YOUNGEST SISTER			46			26	32			45	22	28	23		19				26	37			32	38	17	25
ATTACHED TO	ELDEST BROTHER				56				46	65	35	40	53	45					61			33	58	42	32	39	37
	YOUNGEST BROTHER		76				58	56			28	65	35	50			58			62	44			20	57	20	32
	ELDEST SISTER					47			46	37	29	42	35	29				31				66	79	41	41	46	39
	YOUNGEST SISTER			39			34	45			40	40	28	42		48				45	48			47	75	39	25
SUBMISSIVE TO	ELDEST BROTHER				33				49	45	49	67	73	45					64			44	52	33	29	41	12
	YOUNGEST BROTHER		16				10	08			08	15	05	07			21			12	46				18	30	07
	ELDEST SISTER					42			39	29	14	29	28	10				44				41	25	41	27	38	18
	YOUNGEST SISTER			07			06	17			10	24	11	17		33				28	11			03	12	10	
DOMINANTS	MALES	32	54	36	44	47	48	47	35	42	47	64	44	40	19	19	42	37	28	28	33	24	47	37	26	20	36
	FEMALES	29	19	25	15	11	20	18	15	37	33	27	37	32	31	29	50	31	36	46	40	46	47	41	34	44	32
SUBMISSIVE TO ATTACHED TO																											

TABLE 2

*The percentages were estimated on the basis of the total N rather than the total combined response-frequencies Because of overlap in the responses, the percentages in comparable columns, even if exceeding 100

ences in sibling attitude, rather than differences, objectively, in family-control patterns In order to check the validity of these concepts we correlated the dominance-frequencies reported by each ordinal type (except the onlys) with the frequencies reported by siblings in identical family groups Thus, for example, we correlated the father-dominance data for the older of two males with the same data for the younger of two males, and so on The correlation for father-dominance has yielded a Pearson r of $0.55 \pm .09$, while the correlation for mother-dominance gave us an r of $0.46 \pm .10$

These coefficients indicate a fair amount of validity in the major concepts of the foregoing analysis They show that the concepts do not strictly vary with each ordinal position, but indeed possess *a degree of objectivity justifying their use in studies of family* relationships They further indicate that there is a sizable degree of objectivity in the subjects' reports generally, of which these are merely a sample While, then, passing to an analysis of the reciprocal attitudes of parents and children in terms of more specific concepts, we cannot deny that the more general family-dominance concepts, applicable to the various ordinal positions, suggest certain interesting questions. For one thing, they suggest that the family relationships, taken in toto, tend to grow and change as the family constellation grows and changes. If our analysis is correct, the prevailing forms of family control are a function of the quantitative and qualitative (sex, succession, etc) characteristics of the siblings in the family If this means that attitudes or personalities of parents change with the change of the family *Gestalt,* can it be that ordinal types differ from each other because parents react differently to each of them?

G Favoritism and Discipline

Let us consider the alignment with regard to favoritism and discipline which are closely allied with the matter of family control. The correlation of favorite-sibling frequencies in identical families

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per cent, still give a truer picture of prevailing relationships than could be obtained from balanced percentage figures

**To obtain percentages relating to intra-familial relationships we have dealt with families, in which either older or younger siblings of either sex actually could be found Obviously it would have been inaccurate to set down percentages of brother-to-brother relationships for combined families in some of which there were brothers and in others of which there were none The same is true of sisters

has given us an r of $0.43 \pm .10$ for the father, and $0.51 \pm .10$ for the mother, while the correlation of the disciplined-sibling frequencies in identical families has given us relatively higher coefficients, viz., $0.51 \pm .10$ for the father, and $0.65 \pm .07$ for the mother. It would seem from these figures that there is more likelihood of similar attitudes on discipline than there is on favoritism. Since, in general, we obtained higher frequencies for favoritism than for discipline, the difference between these coefficients may indicate that there is greater consistency among parents in the disciplinary treatment of their children than there is in the expression of favoritism.

Within an arbitrary 10 per cent difference range, we find only eight ordinal types showing tendencies toward *favoritism by both* parents (Table 3). Our case material seems to indicate that the inclusion of the oldest-male-followed-by-male in the favored list, is due to the displacement of favoritism from an older to a younger child (a condition of importance in some other types), and does not occur where the younger is of the same sex as the older child. In regard

TABLE 3
TENDENCY TOWARD PARENTAL FAVORITISM AND REJECTION AS SEEN IN TWENTY-SIX ORDINAL TYPES

Equally favored by father and mother		Favored by father but not by mother		Favored by mother but not by father	
*1.	Oldest male followed by male	1	Younger of 2 males	*1	Only child male
*2	Youngest male preceded by male	*2	Oldest male followed by female	*2	Older of 2 males
*3	Male between two males	3	Younger female preceded by male	*3	Older male followed by female
*4	Male between 2 females			*4.	Younger male preceded by female
*5.	Only child female			*5	Oldest male followed by female
*6	Youngest female preceded by female			*6	Youngest male preceded by female
*7.	Youngest female preceded by male			*7.	Male between female and male
*8.	Female between 2 males			*8	Male between male and female
				9	Older of 2 females
				*10	Oldest female followed by female
				*11	Oldest female followed by male
				*12.	Female between female and male

TABLE 3 (*continued*)

Rejected by mother	Rejected by father	Rejected by mother and father
1 *Younger female* preceded by male	*1 *Only child male*	*1 *Younger of 2 females*
2 Younger of 2 males	*2 Older male followed by female	*2 Female between 2 females
	*3. Older of 2 males	*3. Female between male and female
	*4 Youngest male preceded by female	
	*5 Male between female and male	
	*6 Male between male and female	
	7 *Older of 2 females*	
	8 Older female followed by male	
	*9. Oldest female followed by female	
	*10 Oldest female followed by male	
	*11 Female between female and male	
	*12. Oldest male followed by female	

*Since N differs for various ordinal positions, those whose significance for study is proved by the application of formula $\epsilon_p = \frac{1}{2\sqrt{n}}$ have been marked *by an asterisk*

to the only female child, we find that an only child who tends to be *favored by the father also tends, more or less,* to be favored by the mother The intermediate child is bi-parentally favored when and if it is surrounded by two siblings of the same sex (though not necessarily of the same sex as the intermediate child) Finally, it appears that the youngest of either sex makes considerable demand on the emotions of the parents because, being at the end of the chain, he receives longer care than any of the other children. The rôle of the youngest child in fostering parental narcissism may also be a factor.

Though it is evident that mother-favoritism is more widely distributed than father-favoritism, nevertheless we find that there are some types that *are not favored by the mother but definitely favored by the father* (Table 3) Here it is of equal interest to turn to case material for the interpretation of father-favoritism and mother-rejection In each of the two cases involved we have the younger of two children, preceded by an older brother Evidently the first-born son has a greater claim on the mother's affections than has a younger child of either sex As for father-favoritism, we may as-

sume that the father turns to the younger of two children, when the older is a male, because of the competitive strivings of the older male child, and the greater likelihood of conflict between this child and the father.

The list of those *rejected by the father but favored by the mother* covers 12 ordinal types (Table 3) It is interesting to note that all of them are significantly favored by the mother As for their rejection by the father, it is apparent that the drain on the mother's affections provided by the only, older, or oldest male child, is at the bottom of their conflicts with the father As might be expected, there is every indication that the obverse might be true of the only female child, at least. The older of two females is evidently rejected by the father not because she is replaced by the younger daughter, but because the father may lose interest in both children in that sort of alignment That the similarity of sex in two successive children is the disturbing factor is partly borne out by the fact that the father also rejects the intermediate male child preceded or followed by a male The rejection of the oldest female is explained less by the fact that the mother tends to favor her than by the fact that the father favors a male child following a female, in two-child families; or else chooses the youngest of several children as his favorite. The female between a female and a male, of course, has even less chance of attention, ultimately, than the oldest daughter, and for the same reason But the lack of father-favoritism in the youngest male preceded by a female is difficult to explain, in view of the fact that all other youngest children, regardless of their sex or antecedent, are so favored The only plausible explanation is, then, that the youngest male preceded by a female develops behavior patterns which prevent father-favoritism in an eminent degree The challenge to parental authority, due to the difficulty of father-identification, may in turn explain this child's deviate behavior

Stranger than the fact that some ordinal positions tend to be preferred or rejected by either of the parents is our discovery that there are three ordinal types which tend to be definitely *rejected by the father as well as by the mother* (Table 3) It is worth noting that all three types are females either preceded or followed by females Case material establishes the fact that the rejection of a younger of two females is invariably associated with expressed or implied disappointment over the similarity of the second child's sex

to that of the first If the youngest female preceded by a female tends to be bi-parentally favored, and if the oldest female followed by a female tends to be a mother-favorite, it is obvious that the middle female is left emotionally unattached As a matter of fact, this type, as the second child of the same sex from the outset, proves unable to earn her parent's affection The case of the female preceded by a male and followed by a female, however, is different in that this type, originally favored by the father, suffers a change of relationship through the displacement of the father's affection to the younger sister

H Discipline

Because responses to discipline are heavily tinged with emotion, we obtained positive punishment-frequencies exceeding 50 per cent in but six of the ordinal types Of these, five were female, and one male. In five other cases, the frequencies ranged between 40 and 50 per cent. On these 11 cases we shall base the discussion of the trend of discipline in our ordinal types

Of those showing sizable discipline-frequencies, all but one of the males tend to be disciplined by the father, while all of the female groups running high discipline-frequencies traced their discipline predominantly to the mother Among the males, (*a*) the older male child, and (*b*) the younger, youngest, or middle child preceded by a female, show definite trends in favor of paternal discipline Among the females, (*a*) the older female, (*b*) the oldest female followed by a female, (*c*) the younger of two females, and (*d*) the female between two females, show by substantial figures the frequency of maternal punishment (The youngest female preceded by a male appears to be subject to bi-parental discipline.) Generalizing from our findings, we may say that the older child, regardless of its own sex or the sex of the child following it, tends to be subject to discipline by the parent of his or her own sex Likewise, the younger, or youngest, child preceded by a child of his or her own sex, tends to be subject to discipline by the parent of his or her sex

The relation between parental favoritism and discipline is worth noting. Four variations of these factors appeared possible for each parent The conventional frame of reference calls for an inverse relation between favoritism and discipline, and a direct relation between rejection and punishment (Table 4) While showing that

TABLE 4

INTERRELATION BETWEEN PARENTAL FAVORITISM AND DISCIPLINE IN TWENTY-SIX ORDINAL TYPES

High discipline frequency		Low discipline frequency	
Father (3)	Mother (2)	Father (9)	Mother (19)
High favor frequency			
Older of 2 *m*'s *M* between 2 *f*'s Oldest *m* followed by *f*	Youngest *m* preceded by *m* Oldest of 2 *f*'s Older *f* followed by *m*	Younger of 2 *m*'s Younger *m* preceded by *f* Oldest *m* followed by *m* *M* between 2 *m*'s Only *f* Youngest *f* preceded by *m* Younger *f* preceded by *m* Youngest *f* preceded by *f*	Only *m* Older of 2 *m*'s Older *m* followed by *f* Younger *m* preceded by *f* Oldest *m* followed by *m* Oldest *m* folowed by *f* Youngest *m* preceded by *f* *M* between 2 *m*'s *M* between 2 *f*'s *M* between *f* & *m* *M* between *m* & *f* Only *f* Oldest *f* followed by *f* Oldest *f* followed by *m* Youngest *f* preceded by *m* *F* between 2 *m*'s *F* between *f* & *m* Younger of 2 *m*'s
Father (1)	Mother (3)	Father (13)	Mother (2)
Low favor frequency			
Older *m* followed by *f*	Younger 2 *f*'s Younger *f* preceded by *m* *F* between 2 *f*'s	Only *m* Younger *m* preceded by *f* *M* between *f* & *m* *M* between *m* & *f* Older of 2 *f*'s Older *f* followed by *m* Younger of 2 *f*'s Oldest *f* folowed by *f* Oldest *f* followed by *m* *F* between 2 *f*'s *F* between 2 *m*'s *F* between *f* & *m* *F* between *m* & *f*	Younger of 2 *m* s *F* between *m* & *f*

m=male
f=female

high favoritism-frequencies do indeed correspond with low discipline-frequencies, our data nevertheless brought out the interesting fact that this correspondence is twice as common in the case of mothers (19 positions) as it is in the case of fathers (9 positions). As for the consistency between low favoritism- (i.e., rejection) frequencies and high discipline-frequencies, we find but three ordinal positions in which this is true for mothers, and only one position in which it is true for fathers (Table 4).

Contrary to conventional expectations, furthermore, we have found that low favoritism- (i.e., rejection) frequencies are much more likely to agree with low discipline-frequencies in the father (13 positions) than they are in the mother (2 positions). In other words, rejection is less likely to take the form of punishment in the father than it is in the mother. Not only have we found that parental discipline need not accompany rejection, but we have also found that high favoritism-frequencies may go hand in hand with high discipline-frequencies. This is true in the case of each parent for three different ordinal positions. Thus we might conclude that, while expected relationships do prevail in many ordinal positions, the rejected child is not always a punished child and, conversely, the favored child is not immune to discipline.

I. Domination, Submission and Attachment

In regard to domination of older siblings we find no definite trend. *It is obvious from our data, however, that younger brothers* and sisters do not find themselves in positions of dominance with regard to their older siblings. This distribution is, of course, in accord with common knowledge, and perhaps derives its nature from the cultural stereotypes which do not permit even the admission of such domination.

In regard to the domination of younger brothers we find a determined trend in (*a*) the older of two males, (*b*) the oldest male followed by a male or female, (*c*) the male between two females, and (*d*) the male between a male and a female. What is worthy of notice, perhaps, is the fact that, in the male between two males, and the male between a female and a male, domination of younger brothers is prominently absent; and, also, that it is consistently absent in all female types.

The domination of younger sisters seems to show few decisive

trends. The figures for the older male followed by a female, and the male between two males, approach reliability, but cannot be said to be very striking Similarly with the figures for the oldest female followed by a male and the female between two males Thus, for each sex, the dominant sibling is either an intermediate child surrounded by siblings of similar sexes or an older child followed by a sibling of the opposite sex

The data showing a general absence of domination by younger over older siblings are paralleled by data showing lack of submission on the part of older toward younger siblings. The picture, however, is different as regards submission of younger to older siblings. We find submission to older brothers general for 10 of 12 types who might conceivably claim such relatives The two exceptions are: (*a*) the younger of two males and (*b*) the female between two males

Submission to an older sister is less general than submission to an older brother We find four types submissive to their older sisters, and four types showing no submission trend The exceptions are (*a*) the youngest male preceded by a female (reported by a somewhat unreliable figure), (*b*) the male between two males, (*c*) the male between a female and a male, and (*d*) the female between a female and a male Of these the first three all show submission to an older brother, instead of to an older sister The only exception is the female between a female and a male, who shows no tendency to domination, attachment, or submission in relation to any of her siblings The fact that this type as well as her ordinal siblings, tends to be rejected by the father, may account, in part, for this interesting situation. One of these siblings is, indeed, rejected by both parents Submission to a sibling who himself does not enjoy status in the family can hardly be expected

A crucial test of inter-sibling relationships is the verbalized attachment (used synonymously with devotion or affection) of ordinal types to their siblings. Of the twelve types having older brothers, nine showed more or less definite trends toward such attachment The three exceptions were (*a*) the male between two males, (*b*) the female between two males, and (*c*) the youngest female preceded by a female Substitute attachment to a younger sibling explains, in each case, how these exceptions might come about

Attachment to the older sister, like attachment to the older

brother, shows a number of exceptions In males, it is the four types of intermediate children, and the youngest male preceded by a male, that constitute exceptions In these types there is, however, a decided attachment to an older brother, instead In the females we find our exceptions in (*a*) the female between two males or females, (*b*) the younger of two females, and (*c*) the female between the female and the male. The first three types record substitute loyalty to a younger brother in each case, except in the female between a female and a male, which deviates from the general distribution in several respects, and has been discussed previously

Attachment to younger siblings presents a picture not much different, in essential particulars, from that of attachment to older siblings Of 14 positions involving younger brothers, only four proved to be exceptions These were (*a*) the male between two males, (*b*) the male between a female and a male, (*c*) the female between two females, and (*d*) the female between a male and a female In the first of our male types there is evidence of attachment to the younger sister, and in the second male type attachment is to an older brother *In both female types there is a trend toward attachment to either* of the older siblings As for attachment to the younger sister, we *find five exceptions* to the 14 types involved. These are (*a*) the older male followed by a female, (*b*) the oldest male followed by a female, (*c*) the male between a female and a male, (*d*) the female between a male and a female, and (*e*) the female between a female and a male. In the first of these, where the younger sister is the only other sibling, a strong trend toward domination is evidently inconsistent with attachment In the remaining four types attachment to the younger brother, an older brother, or an older sister either excludes, or tends to compete with, attachment to the younger sister

Since discipline and favoritism in parent-child relations seemed to indicate the possibility of consistent trends, we attempted to analyze the figures in regard to domination and attachment among siblings We have found that domination of younger brothers or sisters is not inconsistent with attachment, and that both attitudes *toward the younger brother* may co-exist in (*a*) the older of two males, (*b*) the oldest male followed by a male, (*c*) the oldest male followed by a female, (*d*) the male between two females, (*e*) the male between the male and the female, and (*f*) the oldest female

followed by a male; and, toward the younger sister, in (*a*) the older male followed by a female, (*b*) the male between two males, and (*c*) the female between two males. In the co-existence of contrary attitudes of this kind we may assume an underlying conflict due in each case, evidently, to the striving of an older child, on the one hand, for the replacement of a younger sibling and, on the other hand, for the deflection to a parental surrogate of impulses growing out of the family romance. The attachment-domination conflict is not, however, always present. In all types showing the presence of attachment toward older siblings, and in several types showing the presence of attachment without domination toward younger siblings, we find evidence of the existence of genuine affection among siblings. There is nothing fortuitous in the fact that the oldest male or female develops a genuine affection toward the youngest (not younger) boy or girl. The exigency of birth in a certain ordinal position dictates a train of circumstances which make affection not merely possible but necessary.

In our study of attachment and submission of siblings in various ordinal positions we have thus found several types in which the attachment to a younger or youngest sibling is coordinate with a non-submission attitude. A striking illustration is the female between two males, where we find a 75 per cent frequency in favor of attachment and only 12 per cent favoring submission. This is also the case with three older-oldest types and with two intermediate types. In only one type (the oldest female followed by a male) have we discovered the presence of submission on the part of an older sibling reporting coincident attachment to the younger sibling. There were also several weak trends toward simultaneous attachment and submission to a younger sister in (*a*) the female between two females, (*b*) the older of two females, (*c*) the oldest female followed by a female, and (*d*) the female between a male and a female. Attachment to older siblings of either sex is, however, coordinate with submission, except in the instance above noted. Only three types have been found to show the presence of submission without an equally reliable trend toward attachment. These are (*a*) the youngest female preceded by a female, (*b*) the male between two males, and (*c*) the male between two females. It is also interesting to note two cases in which there is no trend toward submission but a rather marked trend toward attachment. These are: (*a*) the younger of two males and (*b*) the female between two females.

J Attachment, Domination, and Submission Outside the Family

In the study of the relation of attachment (or expressed affection) of ordinal types to their siblings and their attachment in extra-familial contacts to men and women, we have struck upon several interesting facts It appears from our study that, where attachment to an older or a younger sister is in evidence, there is very high probability that the ordinal type will display attachment to both men and women, regardless of his or her own sex Where exceptions occur, they have reference to female-attachment on the part of those having younger, rather than older, sisters On the other hand, male types reporting a trend toward attachment to older or to younger brothers definitely indicate that attachment to *males* will be evident outside the family, but that attachment to females will be totally lacking. Female types showing attachment to older or younger brothers also show a uniformly marked trend toward attachment to females, but there is high probability, in six of eight types concerned, that female types will not develop attachment toward males outside the family A differential finding of great significance, then, is the fact that first, male and female types who become attached to older or to younger brothers will develop attachment to members of their own sex, but not to members of the opposite sex, and second, that male or female types attached to older or to younger sisters tend to show a consistent trend toward attachment to *either* males or females, the only exceptions being three types having younger sisters

From the foregoing one might feel encouraged to conclude that, in spite of certain qualifications, there is a high degree of interdependence between sibling affection and at least the tendency toward affection to males and females outside the home. An examination of the data on ordinal types showing *no* attachment to siblings, in cases where siblings are normally available, seems to dictate a more cautious attitude We find that in types having siblings to whom they do not claim attachment by significant figures, there is also uniform attachment to males outside the family It is as if a compensatory striving were established in such cases, leading to its resolution in external contacts To those familiar with the ambivalence of sibling attitudes in certain types, where special factors enter in to complicate the situation, these data appear far from questionable

This release of a conflicting attitude is not, however, consistently present in male types (showing no attachment toward siblings) insofar as their extra-familial attachment to females is concerned. It does hold for the attachment of female types claiming no intra-familial attachment, to males outside the family. This is a fact of considerable diagnostic significance.

Submission as an ordinal-type characteristic does not in our data show any relationship to submission outside the family, either to males or to females. This includes submission to older and to younger siblings of both sexes. Where submission outside the family is indicated by figures approaching reliability, we obtained no proof of concomitance with similar relations between siblings. Where intra-familial submission to siblings is, on the other hand, established by unreliable figures there is some proof of concomitance. This may indicate, first of all, that our approach did not secure adequate expression of this attitude. It may also indicate that there is an inverse relation between the attitudes in question.

In regard to domination we may say, first, that no comparison is possible with regard to older siblings, since our data show that they are not generally subject to control by younger siblings. In regard to younger-brother or younger-sister domination we find several facts of interest. The tendency to dominate a younger sister does not appear to affect the trend toward extra-familial domination. On the other hand, the failure of male types to dominate their younger sisters shows a definite tendency to dominate males but not to dominate females. In female types failure to dominate either males or females outside the family is coordinate with the failure to dominate the younger sister. The trend toward the domination of younger brothers seems coordinate in male types, with the tendency to dominate males but not to dominate females. Where there is no domination of younger brothers, in female types, there is likewise no tendency to dominate either males or females outside. In regard to males who do not dominate their younger brothers there is no definite trend.

It is apparent from the foregoing that there is a recognizable relationship between sibling-domination attitudes and similar attitudes toward men and women outside the family. Our findings to this point have been largely concerned with direct, positive or negative, trends along this line. At this point we shall concern ourselves

first, with ordinal types who, dominating neither their brothers nor sisters (with one exception), tend nevertheless to show a marked tendency to dominate males, and to some extent females, outside the family, and second, with ordinal types who dominating neither their brothers nor their sisters, fail likewise to dominate either males or females outside the family

Among those who do not dominate their siblings but tend to dominate either males, or both males and females, we find (*a*) the younger of two males, (*b*) the younger male preceded by a female, (*c*) the youngest male preceded by a male, (*d*) the male between two males, (*e*) the male between a female and male, (*f*) the older female followed by a male, and (*g*) the youngest female preceded by a male The only exception here is the male between two males, who shows a tendency to dominate a younger sister, if he has one We note, however, that each of these types shows a definite, and in two cases a marked, tendency to submit to an older brother or sister Since that alone could not explain the attitude assumed outside the family, we further note that each of these types, except two, is bi-parentally favored, and the two types involved are highly favored by the mother, though rejected by the father

Among types who, like the preceding group, do not dominate their siblings, but, unlike the other group, fail to dominate men or women outside the family, we list (*a*) only children of either sex, (*b*) the older male followed by a female, (*c*) the older of two females, (*d*) the younger female preceded by a male, (*e*) the female between two males, and (*f*) the female between a female and a male The only exception here is the older male followed by a female who manifests a tendency toward the domination of his younger sister The *interesting thing in this group* is that none of these types (except the younger female preceded by a male, who tends to submit to an older brother) shows a propensity toward submission to an older sibling Again we examine the parent-child relationships, and our findings are indeed illuminating Of the seven types listed, all but two (the only female, and the younger female preceded by a male) are rejected by the father, and of these one (the younger *female preceded by a male*) *is rejected* by the mother

With the facts in this and the preceding series before us, we arrive at the principle that, where there is a tendency toward bi-parental favoritism, there is not merely a lack of domination of

younger siblings, but apparently a trend toward submission to older siblings; and a consequent (compensatory) domination of either men, or both men and women, in external contacts. Conversely, with a tendency toward paternal rejection, even if balanced by mother-favoritism, there may be no domination of younger siblings, but neither is there submission to older siblings, and consequently, no ability to dominate men or women in external contacts. Bi-parental indulgence is thus not only a stimulus to adequate adjustment within the home, but serves as a contributing factor to the development of leadership qualities outside it.

K. Summary and Discussion

The analysis of familial and extra-familial trends based on statistical and case material for 26 ordinal types, has given us valuable insights into the mechanics of personality development. Summarizing, we may list the most important of these insights as follows.

1. Family dominance, as used in this study, is not merely a product of individual introspection. The five types of dominance treated appear to have objective existence and to be a function of the family constellation.

2. In order to check the validity of family dominance-patterns, recorded for various ordinal types, we correlated the frequencies reported by sibs in identical family groups. The correlation for father-dominance gave us a Pearson r of $0.55 \pm .09$; and that for mother-dominance was $0.46 \pm .10$.

3. Since parental punishment or favoritism is to some extent a function of the child's response to the parent, we correlated favorite-sibling frequencies in identical families, obtaining an r of $0.43 \pm .10$, for the father, and $0.51 \pm .10$ for the mother.

4. Correlating disciplined-sibling frequencies in identical families, we obtained an r of $0.51 \pm .10$ for the father and $0.65 \pm .07$ for the mother, indicating that there is possibly more consistency in punishment than in favoritism shown by parents to their offspring.

5. Older, oldest, and intermediate types tend to be rejected by the father, but they also tend to be highly favored by the mother. Conversely, the types rejected by the mother are favored by the father.

6. Only eight ordinal types are equally favored by the parents, and three types tend to be rejected by the father and the mother

The types thus rejected are females either preceded or followed by females.

7 The similarity of sexes in previous and succeeding children is a powerful factor influencing child preference The "filial" value of an individual to his parents is in inverse proportion to the number of children of the same sex in the family

8 The displacement of an older child by a younger one is a frequent source of change in parental affections. Priority of birth is, however, an advantage in gaining *maternal* preference The father reacts less favorably to the competitive strivings of the older male child. Hence the younger child is at an advantage in gaining his affection.

9 Mother-favoritism is more widely distributed than father-favoritism, and includes all male types but one: the younger of two males *The mother also rejects one female type: the younger of* two children preceded by a male

10 All but one of the males tend to be disciplined by the father, while all of the female punishment tends to be meted out by the mother

11. The older child tends to be disciplined by the parent of his or her own sex. The younger or youngest child, preceded by a child of his or her own sex, is also subject to discipline by the parents of his or her own sex

12 Parental rejection and parental discipline do not appear to be synonymous Favorite ordinal types may be punished, though *rejection* and punishment are more strictly coordinate with each other

13 In all types showing the presence of attachment without domination toward younger sibs, we find evidence of genuine affection among sibs

14 There is no definite trend in regard to the domination of older sibs and, conversely, there is lack of submission on the part of older toward younger sibs

15. There is a consistent lack of domination, on the part of female types, toward their younger male sibs Similarly, the domination of younger sisters by male types seems to show few decisive trends

16 The tendency to dominate a younger female sib does not affect the trend toward extra-familial domination. Failure to domi-

nate a younger sister, in male types, is coordinate with the tendency to dominate males but not females. Failure to dominate a younger sister, in female types, means failure to dominate either males or females outside the family.

17. Types attached to older or to younger male sibs tend to be attached to males but not to members of the opposite sex outside the family, whereas male types attached to older or younger sisters show a consistent trend toward attachment to either males or females. Lack of attachment to siblings does not preclude the attachment of male types to males, but it does affect the attachment of female ordinal types to males or females outside.

18. The ability to dominate either males or females outside the family seems to be consistent with bi-parental favoritism, while the lack of ability to dominate males or females seems to be contingent on father-rejection, even if compensated by maternal favoritism.

Thus we arrive at the end of the comparative analysis of attitudes underlying social adjustment in 26 ordinal types. By keeping the relationships constant, we have found it useful to manipulate the types singly in order to discover differential trends. Yet, if our classification of types may lay claim to validity, it must make it possible for us to discover differences not merely in particular relationships but in total constellations of factors affecting individuals in various positions. We have thus attempted, by holding the ordinal types constant, to search for differential trends in the total alignment of intra- and extra-familial factors discussed. A predictive table based on the 28 factors involved, gives us a bird's-eye-view of trends in each of the ordinal positions which, when refined, should be of considerable value. Prediction as to future marital adjustment, vocational choices demanding certain kinds of social skills, and finally possibilities of social leadership are all revealed in the categories dealt with.

Obviously, to say that an ordinal classification of the kind employed is promising of fruitful results is not to overlook its limitations. In individual cases, other variables than those considered may enter in to alter the trends discovered for a given position. One of these variables may be the sex-expectations of the father and/or the mother, particularly in the light of certain cultural determinants. Another possibility is that the physical similarity of the child to one of the parents will lead to the projection of unfulfilled

ambitions or of introjected hatreds on the child, as a result. The death, lingering illness, physical deformity, or mental deficiency of the sibling just older or just younger may create a psychological vacuum in expectation of another birth, and thus account for the deviation from a typical ordinal trend The death of one or both of the parents may be expected to alter the ordinal picture

In general, too, it must not be forgotten that different positions may show similar trends in certain particulars, for here, as elsewhere, the law of limited possibilities is bound to operate Perhaps more refined measures than those employed in this study, a larger number of cases for some ordinal types, and additional or new categories, will be necessary to discover differences where similarities are now indicated In any case, the application of similar techniques to the study of the 26 ordinal types should make the revaluation of much previous work possible In this new classification may lie the answer to many of the problems which other investigators have found it difficult to treat

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Acknowledgment is made of service rendered by the Works Progress Administration and the Museum Extension Project of the Chicago Board of Education in the preparation of Table 2 for classroom use Thanks are due Mr Roy J Battis, superintendent of the Project, and Dean W H Conley, chairman of the supervising committee, for permission to publish the table as part of the present study

The Journal of Genetic Psychology, 1939, 55, 31-48

THE INTELLIGENCE OF THE HARD OF HEARING SCHOOL CHILD*[1]

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This study deals with intelligence tests given to hard of hearing school children. Previous studies are few and have been well summarized by Madden (1) so that no résumé need be given here. In general these studies have shown a slightly lower intelligence for the hard of hearing child when compared with the normal hearing child. Our study has tried to obtain larger and more homogeneous samples. We have also used two different types of intelligence tests.

A. Selection of Subjects

The names of the children selected for testing were obtained from the records maintained by the New York League for the Hard of Hearing and supplied by the project of the W P A which carried out the tests of hearing. These records give for each hard of hearing child the results of the 4*A* audiometer test, 2*A* audiometer test, and the recommendations of the otologist.

For the purpose of the present study, children from the fifth and sixth grades formed the chief sample. This restricts the subjects to a narrow age and school range and omits all consideration of children in ungraded classes. On the other hand the subjects selected came from many schools and form a good representative sample of all fifth and sixth grade children in New York City schools. In addition, a small sample of children in Grades 7 and 8 were tested. They will be considered later on in this article. The main group,

*Received in the Editorial Office on August 10, 1938.

[1]Acknowledgment is made to the United States Works Progress Administration to the City of New York for assistance rendered under Project Number 465-97-3-102. Extensive studies dealing with the psychological characteristics of the various physically handicapped groups are being carried on by this project. The present article is one of a series presenting results derived from these investigations.

[2]We wish to acknowledge our indebtedness to the New York League for the Hard of Hearing for their splendid cooperation in making their records available to us.

however, consists of 1,186 hard of hearing children in Grades 5 and 6.

In most cases the subjects selected for the present study had only recently been tested for hearing impairment. Whenever more than one test had been given to a child only the latest record was used. Children were regarded as hard of hearing only if they had shown hearing impairment by the individual 2*A* audiometer test and the otological test. For these children, records were taken of the 4*A* audiometer test scores, the 2*A* total scores, and the 2*A* speech scores.

In this study hearing loss as measured by the 2*A* audiometer for the speech tones has been used. The scores on this test were used because it is a reliable individual test of hearing, and the speech tones were chosen because hearing impairment in this tonal area is most likely to influence work in school and also, perhaps, the general development of verbal intelligence.

In Figure 1 the distributions of all hard of hearing children in

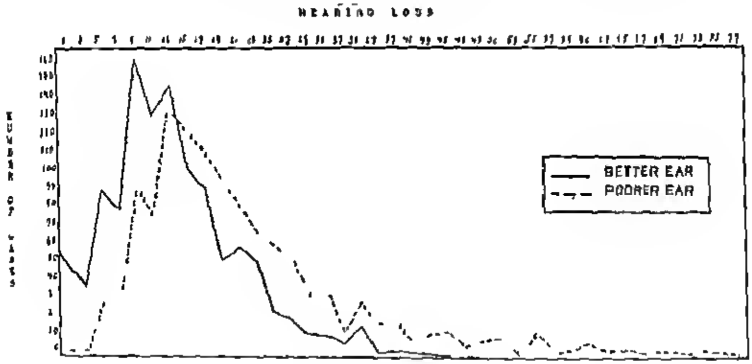

FIGURE 1
DISTRIBUTION OF CASES BY MEASURE OF HEARING LOSS ON 2A AUDIOMETER

the fifth and sixth grades according to 2*A* speech score in decibels on the better and poorer ear are given.

For the purpose of making comparisons with children having no hearing impairment at all, a group of normal hearing children from the fifth and sixth grades was studied. The selection of this control group will be described below.

The subjects who were studied, both hard of hearing and normal,

will be considered as four samples. The samples are set up in chronological order depending on the period of study. For each sample, the sexes will be considered separately.

1. *Sample I*

This sample is made up of children who were examined before July, 1936. The hard of hearing in this sample were selected from 44 schools in Brooklyn, Bronx, Manhattan, and Queens. The total number studied consists of

Boys	281
Girls	329

The parallel group of normal children was selected from 30 schools in the same boroughs. Twenty-six of these schools are identical with the schools from which the hard of hearing were derived. A total number of 1,040 were so obtained. It was found, however, that 547 of these came from only three schools. In order not to weight the control group too heavily with the group from only three schools, the bulk of the data on these children was rejected, only results on enough children were left to make up a number about equal to the hard of hearing children in these schools. The final number of normal hearing children in Sample I is

Boys	311
Girls	230

2. *Sample II*

The children in this sample were studied during the period of October, 1936, to June, 1937. The hard of hearing were selected from 35 schools in the Bronx, Brooklyn, and Manhattan. The selection of the control group was done more carefully than in the case of Sample I. They were matched nearly one for one to the hard of hearing by sex and class. The number in this sample is:

	Hard of Hearing	*Normal*
Boys	214	285
Girls	186	253

3. *Sample III*

The children in this sample were studied in the period from September, 1937, to January, 1938. The method of selection of cases is the same as that used in Sample II. The children were

selected from 21 schools in the Bronx, Brooklyn, and Manhattan The total number in this sample is:

	Hard of Hearing	*Normal*
Boys	104	115
Girls	72	92

In spite of the fact that the selection of cases in this sample is the same as that in the previous one, it seemed desirable to keep it separate because of certain peculiarities shown by this sample

4. *Sample IV*

A group of hard of hearing children in Grades 7 and 8 were selected and tested in the same manner as the hard of hearing children in other samples. The number in this sample is:

	Hard of Hearing	*Normal*
Boys	81	99
Girls	137	171

B Intelligence Tests

All the children, hard of hearing and normal hearing, were given the Pintner Intelligence Test (3). This is a group test of the usual type, being predominantly verbal in content and depending upon oral and printed directions. A small sample of hard of hearing and normal children were given the Pintner-Non-Language Mental Test (4). This is a group test in which the content is entirely non-verbal, and for which the directions are given entirely without the use of language, that is to say, by means of pantomime and samples on the black-board Severe hearing impairment or even total deafness is no handicap in understanding the directions for this test

1 *Results on Verbal Intelligence*

We shall present first the results of the three main samples in Grades 5 and 6 as tested on the Pintner Intelligence Test.

Table 1 shows the results in terms of *IQ* for each of the samples and for each sex

The mean *IQ* for each sample for each sex is below the test norm The mean *IQ* for the total of 1,186 hard of hearing children is 95. The difference of 5 points between this mean and 100 *IQ* is statistically significant as is indicated by the fact that the standard error of the mean for all cases is .70

TABLE 1

MEAN *IQ* FOR SAMPLES IN GRADES 5 AND 7

Sample		Number	Mean	Sigma	Sigma mean
I	Boys	281	98.67	25.47	1.52
	Girls	329	94.27	23.90	1.29
II	Boys	214	93.87	24.51	1.68
	Girls	186	90.47	21.23	1.56
III	Boys	104	91.40	21.46	2.10
	Girls	72	98.88	27.65	3.26
All cases		1186	94.67	24.12	.70

On the basis of this value and using the table of areas under the normal probability curve, the probability that the true mean for the hard of hearing shall be as high as 97.0 is less than .001. Hence *on the basis of the test norms, the hard of hearing are inferior to the population as a whole in intelligence.*

Another approach to the problem of the relation of hearing impairment to intelligence can be obtained by considering the correlation between hearing loss as measured by the 2*A* audiometer on the speech tones and *IQ*. Table 2 lists the correlations for the samples separately in relation to better ear and poorer ear.

TABLE 2

RELATION OF HEARING LOSS TO *IQ*

Sample		Number	Correlation with loss on better ear	Correlation with loss on poorer ear
I	Boys	281	—.078	—.052
	Girls	329	—.131	—.029
II	Boys	214	—.084	.023
	Girls	186	—.095	—.044
III	Boys	104	.063	—.035
	Girls	72	.196	.012
All cases		1186	—.045	—.016

As is to be expected most of the correlations of *IQ* with hearing loss are negative. These correlations are, however, not statistically significant. The standard error of *r* for the 1,186 cases is .029. With this value the larger of the two correlations, the one for the

better ear is only —1.6 times its standard error. Hence the result cannot be considered statistically significant.

It is worth while approaching this problem in another way. This approach will consider the contributions of the various groups as independent observations on the true correlation. In this way, six estimates of the correlation are available. The observations can then be combined into a single value by a method of averaging. A procedure for this is described by R. A. Fisher (1). In this procedure the r's are converted into certain new values called z's by use of Table 5 *B* in Fisher's book. A weighted average of these z's is obtained by use of the number of cases. The formula for averaging is

$$\bar{z} = \frac{\Sigma\,(N\text{-}3)\,Z}{\Sigma\,(N\text{-}3)}$$

The significance of z is obtained from its standard error which is:

$$\bar{z} = 1 \;/\; \sqrt{\Sigma\,(N\text{-}3)}$$

The calculations are carried out in Table 3 for the correlations with the better ear.

TABLE 3

Sample		r	Z	N-3	(N-3) Z
I	Boys	—.078	—.078	278	—21.684
	Girls	—.131	—.132	326	—43.032
II	Boys	—.084	—.084	211	—17.724
	Girls	—.095	—.095	183	—17.385
III	Boys	.063	.063	101	6.363
	Girls	.196	.199	69	13.731
TOTALS				1168	79.731

In the first column are listed the correlations of *IQ* with hearing loss in the better ear. The corresponding values of z are in the second column. The figures in the third column are each three less than the number of cases. In the fourth column are the products of the corresponding figures in the second and third columns. To obtain the average value of z called $\bar{z}$, the total in the fourth column is divided by the total in the third.

This gives

$$\bar{z} = -.068$$

The value of the standard error of $\bar{z}$ is.

$$\sigma_{\bar{z}} = \frac{1}{\sqrt{1168}} = .029$$

Hence $\bar{z}$ is 2.3 times its standard error which indicates significance.

It is worth while considering the combined correlation obtained from Samples I and II when both sexes are considered jointly. The correlation so obtained for the better ear is

$$r = -.077$$

For this correlation based on 1,010 cases:

$$\sigma_r = .031$$

Hence

$$\frac{r}{\sigma_r} = -2.5$$

which is statistically significant.

It seems likely that the correlations of Sample III are not satisfactory estimates of the true correlation. The introduction of this sample has the influence on the total correlation of lowering it to a point at which it no longer indicates statistical significance. Nevertheless, the estimates obtained from a consideration of the average z and from Samples I and II show sufficient significance to suggest that the true correlation between *IQ* and hearing loss is negative.

Since hearing scores are available for both ears, it is natural to try to find the relationship between *IQ* and the hearing loss for the two ears jointly. This problem leads to the evaluation of the multiple correlation between *IQ* as the dependent variate and the measures of hearing loss in better and poorer ears as independent variates. For this purpose, the three correlations among the three variates are required. The correlations between hearing loss and *IQ* for both ears are found by means of the z method outlined above, i.e., by averaging the r's. The correlation between the measures for the two ears was found by direct evaluation for all samples combined. The resulting correlations are:

IQ and better ear	—.068
IQ and poorer ear	—.026
Poorer and better ear	.14

The multiple correlation resulting from this is.

$$R = -.068$$

This multiple correlation substantiates previous information and indicates that *the effect of hearing impairment on intelligence is* essentially determined by the better ear

Additional evidence bearing on the relation of hearing impairment to IQ is obtained from a consideration of the normal control groups Table 4 presents the IQ averages for the control groups in juxta-

TABLE 4

AVERAGE IQ OF NORMAL AND HARD OF HEARING GROUPS, 5TH AND 6TH GRADES

Sample	Hearing group	*Boys* Number	Mean	σ	*Girls* Number	Mean	σ
I	Normal	311	104.15	25.57	230	105.50	25.25
	Hard of Hearing	281	98.67	25.47	329	94.27	23.90
	Extreme Hard of Hearing	107	95.51	24.48	170	91.38	22.54
II	Normal	285	98.66	23.59	253	92.91	21.32
	Hard of Hearing	214	93.87	24.51	186	90.47	21.23
	Extreme Hard of Hearing	58	39.93	24.24	45	85.67	23.95
III	Normal	115	96.48	24.12	92	96.78	25.14
	Hard of Hearing	104	91.40	21.46	72	98.88	27.65
	Extreme Hard of Hearing	37	93.35	18.92	44	101.09	30.18

position to the averages from the hard of hearing groups. For the latter the average IQ scores are presented for all the hard of hearing as given in Table 1. In addition, average IQ scores are shown for groups having hearing loss of 15 decibels or more in both ears. These groups are called extreme hard of hearing. They are included also in the total hard of hearing groups

The theory that hearing impairment is associated with a lowering of IQ is verified in this table In five of the six comparisons, the hard of hearing have lower IQ's than the normal. This is even more true of the extreme hard of hearing groups In each case except one, these show a lower IQ than the normal, the exception being the group of girls in Sample III This group is indeed unusual as was shown by the positive correlation in Table 2 In fact this group has an average IQ of over 100 The data in Table 4

verify the correlations in Table 2, since Samples I and II show lower *IQ*'s for the extreme groups than for the entire groups whereas Sample III shows a trend in the opposite direction

In order to view the entire picture presented by all cases considered jointly, the results are combined in Table 5

TABLE 5
COMPARISON OF NORMAL AND HARD OF HEARING

Hearing Groups	Number	Mean	σ	Mean *Diff*	σ *Diff*	$\frac{M\ Diff}{\sigma\ Diff}$
Normal	1286	99 75	24 55			
All H of H	1186	94 67	24 12	5 08	982	5 2
Ext H of H	461	92 47	24 57	7 28	1 334	5 5

Here we note that the control group of normal hearing children has a mean *IQ* of 99 75, i e., practically 100 This means that our control group is a satisfactory sample of the children in the city schools The total hard of hearing obtain a mean *IQ* of 94 67, or 5 08 points less than the control. Although this is a small difference, it is a statistically significant one If now we take the extreme hard of hearing cases alone we find that their mean *IQ* of 92 47 drops slightly below the mean of all the hard of hearing and drops 7 28 points below the control There can be no doubt that the extreme hard of hearing cases have a definitely lower *IQ* than normal hearing children.

The facts so far presented indicate strongly that the hard of hearing have a lower *IQ* than the normal hearing These results are expressed only in terms of averages They do not at all indicate that the hard of hearing child is necessarily stupid In fact, many of the hard of hearing children in this study have very high intelligence This is shown very clearly in Figure 2

In this graph, distributions are given for the total normal group, the hard of hearing and the extreme groups As is shown in the graph, the range is the same for all groups and the distributions are very similar Nevertheless the hard of hearing curves are to the left of the normal, showing that hearing impairment is related to a lowering of the *IQ*.

The results obtained from the fifth and sixth grade samples are verified by additional results derived from a smaller sample of seventh and eighth grade children Table 6 lists the mean *IQ*'s for the

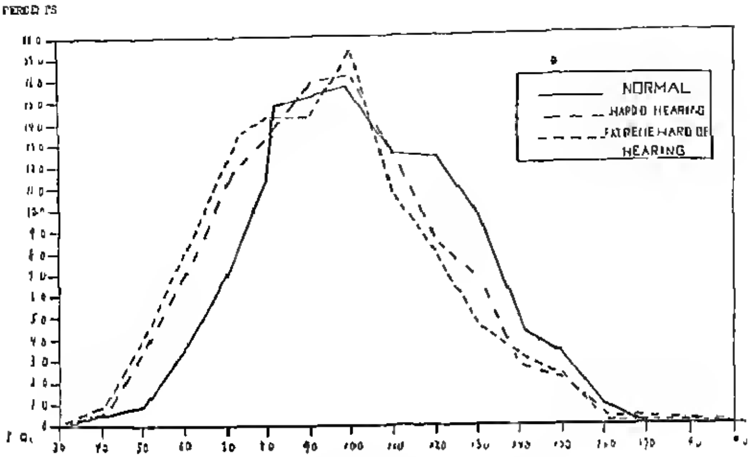

FIGURE 2
DISTRIBUTION OF INTELLIGENCE QUOTIENTS

TABLE 6
MEAN *IQ* SCORES OF NORMAL AND HARD OF HEARING CHILDREN IN THE SEVENTH AND EIGHTH GRADES

	Boys			Girls		
	Number	Mean	σ	Number	Mean	σ
Normal	99	103.4	21.7	171	105.2	21.3
Hard of Hearing	81	94.2	22.0	137	95.0	18.1
Extreme H. of H	36	92.3	22.0	69	91.7	16.7

hard of hearing and normal control groups for boys and girls separately. Children having a hearing loss in the better ear of 15 or more decibels are listed as extreme hard of hearing.

The results in Table 6 indicate even sharper differences between normal and hard of hearing than are found for the fifth and sixth grade group. The drop below the norm for the hard of hearing is 5 points. The control group, however, chosen from the same classes as the hard of hearing, has a higher average than the norm.

A similar result is indicated in the case of the correlations given in Table 7.

As in the case of the fifth and sixth grade groups the correlations are small and negative though larger than those for the younger

TABLE 7

CORRELATIONS OF *IQ* WITH HEARING LOSS FOR 7TH AND 8TH GRADE CHILDREN

	Number	Correlations with Better ear	Poorer ear
Boys	81	—.116	—.145
Girls	137	—.135	—.088

groups The correlations are in themselves not significant because of the small numbers of cases They may, however, be combined with the correlations listed in Table 2, by the *z* method of Fisher described above This method yields an average *z* value for the correlations with better ear which is given by

$$\bar{z} = -.078.$$

The standard error of this value is

$$\sigma_{\bar{z}} = .028$$

Hence $\bar{z}$ is —2.8 times its standard error, a result which is statistically significant

The results from the seventh and eighth grade children confirm the previous conclusion that hearing impairment is definitely accompanied by impairment in intelligence

The extent of this impairment can also be estimated in terms of mental age To obtain the difference in mental age the medians and quartiles of the normal and hard of hearing groups are compared in Table 8

TABLE 8

COMPARISON IN TERMS OF *MA* AND *CA* OF NORMAL AND HARD OF HEARING GROUPS, 5TH AND 6TH GRADE CHILDREN

	First Quartile	Median	Third Quartile
	Mental Ages		
Normal	9 yrs 7 mo	11 yrs 4 mo	13 yrs 2 mo
Hard of Hearing	9 yrs	10 yrs 7 mo	12 yrs 4 mo
Extreme H of H	8 yrs 9 mo	10 yrs 5 mo	12 yrs 2 mo
	Chronological Ages		
Normal	10 yrs 6 mo	11 yrs 1 mo	11 yrs 9 mo
Hard of Hearing	10 yrs 8 mo	11 yrs 2 mo	11 yrs 10 mo
Extreme H of H	10 yrs 8 mo	11 yrs 3 mo	12 yrs 0 mo

The differences between the groups are striking The median of the normal group is nine months above that of the total hard of

hearing and eleven months higher than the median of the extreme hard of hearing group The significance of the difference in mental ages depends upon the difference in chronological ages between the groups. The median and quartile ages are also given in Table 8

It is clear from this table that the chronological age difference between the two groups is not great. The normal group is somewhat younger than the hard of hearing, a fact which emphasizes the differences in mental age

2 *Non-Language Intelligence*

The results obtained from the administration of the Pintner Non-Language Test will be presented in this section These results will be compared with information obtained from the administration of the verbal test By this means the influence of the verbal factor on the intelligence of the hard of hearing will be estimated.

Tables 9 and 10 summarize the results on verbal and non-language intelligence obtained in this study.

TABLE 9
AVERAGE *IQ*'S OF NORMAL AND HARD OF HEARING GROUPS
(*IQ* BASED ON VERBAL INTELLIGENCE TEST)

Sample		Hearing groups	Boys Number	Boys Mean	Boys σ	Girls Number	Girls Mean	Girls σ
I	5th & 6th Grades	Normal hearing	711	100 88	24 78	575	98 57	24 29
		All hard of hearing	599	95 69	24 65	587	93 63	23 74
		Extreme hard of hearing	202	93 51	23 61	259	92 04	24 68
II	7th & 8th Grades	Normal hearing	99	103 415	21 730	171	105 245	21 275
		All hard of hearing	81	94 22	22 01	137	94 995	18 135
		Extreme hard of hearing	36	92 28	22 02	69	91 71	16 745

Table 9 gives the results obtained from the Pintner Intelligence Test. This table shows clearly that the hard of hearing have a lower *IQ* than the normal and that the extreme hard of hearing have an even lower *IQ* than the total group. This result is true in all grades studied and in both sexes. Table 10 which gives the results for the Non-Language Test does not show this regular de-

TABLE 10

Average IQ's of Normal and Hard of Hearing Groups
(IQ Based on Non-Language Intelligence Test)

Sample		Hearing groups	Boys Number	Boys Mean	Boys σ	Girls Number	Girls Mean	Girls σ
I	5th & 6th Grades	Normal hearing	69	103.60	22.47	53	99.83	26.56
		All hard of hearing	70	98.79	20.57	45	103.89	22.33
		Extreme hard of hearing	27	96.45	18.77	26	109.5	24.03
II	7th & 8th Grades	Normal hearing	106	103.61	20.73	144	101.27	19.22
		All hard of hearing	86	96.94	21.37	114	99.55	17.59
		Extreme hard of hearing	39	96.11	21.66	48	99.92	17.85

crease in average IQ. The girls do not show it at all. The boys show it only in the fifth and sixth grade groups. In only one instance do the extreme hard of hearing fall below the entire hard of hearing group.

The results obtained by combining all cases for each test are given in Table 11.

TABLE 11

Comparison of Normal and Hard of Hearing

Hearing Group	Number	Mean		*M Diff*	*Diff*	*M Diff* / *Diff*
		Verbal IQ				
Normal hearing	1556	100.59	24.1			
All hard of hearing	1404	94.68	23.5	5.91	.87	6.7
Extreme hard of hearing	566	92.36	23.5	8.22	1.16	7.0
		Non-Language IQ				
Normal hearing	372	102.16	21.5			
All hard of hearing	315	99.29	20.5	2.86	1.60	1.8
Extreme hard of hearing	140	99.26	21.0	2.89	2.09	1.4

Table 11 shows even more clearly than the previous tables the extent to which the gap between the normal and hard of hearing is reduced by the Non-Language Test. Differences of six and eight points in IQ are reduced to less than three. In fact the differences in the Non-Language Test are not shown to be significant. It ap-

pears therefore, that the verbal factor in intelligence is what causes the difference between the normal and hard of hearing.

The difference between verbal and non-language intelligence in relation to the hard of hearing is shown more clearly in the consideration of a group of hard of hearing children who took both tests. The tables which follow compare intelligence quotients for the two groups and show to what extent the hard of hearing approach the normal on non-language intelligence. A comparison of the mean *IQ* for each type of intelligence is given in Table 12.

TABLE 12

COMPARISON OF MEAN VERBAL AND NON-LANGUAGE *IQ*'s FOR SAMPLES OF HARD OF HEARING

Test	Number	Mean		*r*	*M Diff*	*Diff*	*M Diff* / *Diff.*
		Grades 5 & 6					
Verbal	115	95.48	21.5				
Non-language	115	100.57	22.1	.06	5.09	2.9	1.7
		Grades 7 & 8					
Verbal	175	94.95	18.5				
Non-language	175	99.17	18.7	.48	4.2	1.5	2.8
		All cases					
Verbal	290	95.16	20.5				
Non-language	290	99.73	20.1	.30	4.6	1.7	2.7

This table shows that the non-language *IQ*'s of the hard of hearing are distinctly higher than their verbal *IQ*'s. Two of the differences are statistically significant to a high degree. In fact these children who fall below the normal in verbal intelligence come right up to the norms found for the normal in non-language intelligence.

It is worth while examining the sample of fifth and sixth grade children more closely. The boys and girls in this sample respond quite differently to this test as is shown in Table 13.

TABLE 13

COMPARISON OF MEAN *IQ* ON VERBAL AND NON-LANGUAGE TESTS FOR IDENTICAL CASES OF HARD OF HEARING

Test	Boys Number	Boys Mean	Boys σ	Girls Number	Girls Mean	Girls σ
Verbal	70	90.29	20.66	45	104	27.55
Non-language	70	98.8	21.57	45	103.8	23.24

It is not at all clear from this table that there is a sex difference indicated. The interest in this table lies in the fact that the non-language test tends to equalize the means for the two groups. The boys who have a low verbal *IQ* are shown to have a normal non-language *IQ*. The girls with a high verbal *IQ* also have a high non-language *IQ*.

The high verbal *IQ* found for the girls in the fifth and sixth grade group emphasizes once more the peculiarity of this sample. An examination of earlier samples shows that in every case except this the average *IQ* was below 100. In this sample the *IQ* is above 100. Another manifestation of the peculiarity of this group of girls is the fact that the correlation of *IQ* with hearing loss is positive as was shown in Table 2.

Correlations with hearing loss in the better ear for both the non-language *IQ* and verbal *IQ* for hard of hearing children who took both tests are shown in Table 14. The correlations for the fifth

TABLE 14

CORRELATIONS OF NON-LANGUAGE AND VERBAL *IQ*'S WITH HEARING LOSS FOR HARD OF HEARING CHILDREN WHO TOOK BOTH TESTS

		Number	Verbal *IQ*	Non-language *IQ*
5th and 6th Grades	Boys	70	038	—046
	Girls	45	319	251
7th and 8th Grades	Boys	70	—078	175
	Girls	105	—069	179

and sixth grade groups are not to be regarded as typical, particularly in the case of the girls, as has been pointed out. The seventh and eighth grade sample does, however, appear to be representative. From this it appears that whereas the verbal *IQ*'s have a negative correlation with hearing loss the non-language *IQ*'s are correlated positively with it. This result indicates more fully that the intelligence difficulty of the hard of hearing is largely verbal.

The higher *IQ*'s of the hard of hearing on the non-language test are not due to any peculiarity of the standardization of the test whereby all children might make higher *IQ*'s on this test. Normal hearing children make the same average *IQ* on both verbal and non-language tests, just as they should if the standardizations of both tests are adequate. Table 15 shows samples of normal hearing

TABLE 15

MEAN VERBAL AND NON-LANGUAGE *IQ*'S OF SAMPLES OF NORMAL HEARING CHILDREN WHO TOOK BOTH TESTS

Sample	Number	Mean	σ
	Verbal IQ		
5th & 6th Grades	120	101.6	23.5
7th & 8th Grades	194	102.6	22.7
	Non-language IQ		
5th & 6th Grades	120	99.7	23.5
7th & 8th Grades	194	102.2	18.6

children who were used as controls and were given both tests. The mean *IQ*'s and the sigmas are practically the same for both tests. Hence the difference between the two tests found among the hard of hearing are not due to any differences in the standardization of the tests themselves.

C. SUMMARY

This report deals with the intelligence of the hard of hearing school child as measured by two different types of test, namely verbal and non-language.

The hard of hearing children were those who were diagnosed as having hearing impairment after having been tested by the 4A and 2A audiometers and after having had an otological examination by competent otologists. The hearing loss used in our study is the average hearing loss on the speech tones on the 2A audiometer.

A total of 1,404 hard of hearing and 1,556 normal hearing children were tested by means of a verbal intelligence test (the Pintner Intelligence Test). A total of 315 hard of hearing and 372 normal hearing were tested by means of a non-language intelligence test (the Pintner Non-Language Mental Test). All these children were in Grades 5 to 8 inclusive in the public schools of New York City.

The mean verbal *IQ* for the normal hearing group is 100.6, for the hard of hearing group 94.7. This difference is statistically significant. The mean *IQ* for those who are very hard of hearing is 92.4, somewhat lower than the *IQ* for the hard of hearing group in general. Almost all the correlations between amount of hearing loss and verbal intelligence are small but negative. The hard of hearing child is slightly handicapped with reference to the usual verbal intelligence test.

The mean non-language *IQ* for the normal hearing group is 102 2, for the hard of hearing group 99 3 This difference is small and is not statistically significant The mean non-language *IQ* for the very hard of hearing is 99 3, the same as for the whole hard of hearing group The correlations between loss of hearing and *IQ* for non-verbal intelligence are very small and tend to be positive rather than negative There seems, therefore, to be no difference in non-language intelligence between the normal and hard of hearing

These results seem to us to indicate a slight handicap so far as the acquisition of language is concerned on the part of the hard of hearing school child. His hearing loss makes it a little more difficult for him to acquire the same proficiency in language as the normal hearing school child Because of this he finds it a little more difficult to keep up with the normal hearing child in his progress through the grades He scores a little lower on the usual educational achievement test School work is predominantly dependent upon verbal achievement, hence the slight handicap of the hard of hearing child, at least in the grades This slight retardation in language is reflected in the usual verbal intelligence test, and therefore the lower verbal *IQ* of the hard of hearing group If we take this verbal *IQ* as a measure of general intelligence, we would be bound to conclude that the hard of hearing child is somewhat lower in general intelligence than the hearing child We do not subscribe to this conclusion Intelligence can be measured in other ways than by means of language Where a handicap in the acquisition of language occurs, a verbal intelligence test is not the best means for a measure of general intelligence A non-language test should be used When we use such a test, we find that the difference in *IQ* between the hard of hearing and the normal hearing is reduced practically to zero Our conclusion therefore is that there is no real difference in basic general intelligence between hard of hearing and normal hearing school children in the grades The hard of hearing suffer from a very slight handicap in the acquisition of language which is reflected in their scores on verbal intelligence tests and in the academic part of their school work.

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The Journal of Genetic Psychology, 1939, **55**, 49-58

FORWARD CONDITIONING, BACKWARD CONDITIONING, AND PSEUDO-CONDITIONING IN THE GOLDFISH*

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A. PURPOSE

The purpose of the following experiment was to study the formation of new stimulus-response capacities in the goldfish (*Carassius auratus*). Although tests were made for delayed and trace forward conditioned reflexes and for backward conditioned reflexes, the primary emphasis was placed upon the phenomenon of "pseudo-conditioning," described by Grether (4) in a previous article, in which the substitute stimuli are never paired with the original stimuli but attain the capacity to elicit a response spontaneously after the original stimulus (a strong, shock stimulus) has been presented a number of times.

B. PERTINENT LITERATURE

The literature of conditioning in fish not only proves that conditioning can take place, but also shows clearly that true conditioned inhibition [Froloff (3)] and conditioned discrimination [Froloff (2), Bull (1)] can be established. There is also substantial evidence that such conditioned responses are retained for a considerable period of time, a week to a month or longer.

The observations of Sears (5) made on two goldfish are of particular importance to the problems of this paper since Sears not only described "pseudo-conditioning" but also discussed its characteristics of fairly rapid acquisition (less than 70 trials), resistance to "experimental extinction," and good retention. Furthermore, Sears interpreted this phenomenon correctly as being a cortical dominant, "pro-

*Received in the Editorial Office on August 13, 1938.

[1]The author wishes to express thanks to Mrs. Norma Metzner, Miss Rachel Starr, and Miss Audrey Beatty who assisted in conducting the reported experiments.

This research was supported in part by a grant from WPA.

duced . by either *strong external stimulation*[2] or by secretion of certain hormones " Sears, however, chose deliberately not to investigate the phenomenon further in his study of the effect of optic lobe ablation

Sears did not point out that his observations differed in one characteristic (probably more apparent than real) from those of the other workers who had investigated the dominant in frogs, toads, cats, and dogs The dominant of earlier workers was obtained as a result of hormic or of visceral afferent stimulation of centers in the nervous system Sears' dominant was induced as a result of *external afferent stimulation* The dominant of the earlier workers explained how the organization of primarily *unlearned, inherent* responses took place The dominant described by Sears was a new, *individual* acquisition, a special (learned?) capacity of the particular animal, not of the species. Furthermore, in spite of the fact that earlier workers [Ufland (7), Uchtomsky (6)] had claimed "persistence" to be one of the characteristics of the dominant, the new stimulus-response capacities in their studies persisted little if any longer than the primary stimulating agency, e.g., the hormones of visceral tensions The dominant obtained by Sears obviously persisted long after the stimulation source, external afferent stimulation had ceased, since great difficulty was encountered in "experimentally extinguishing" these connections Sears' work suggests and Grether's work proves that dominants established by strong exteroceptive stimulation may persist for at least as long as most response patterns acquired by paired stimulation.

C SUBJECTS, APPARATUS, GENERAL METHOD

Forty-nine goldfish (*Carrassius auratus*) were used as subjects Between test periods these animals were kept, singly or in pairs, in a separate "home" room in small glass containers 2.5 x 3.5 x 7 5 inches in size The test chamber was a glass bowl 3 inches deep and 12 inches square. Each of two opposite sides of the test chamber was lined with a copper electrode, covered on the exterior with a piece of perforated cardboard which prevented the fish from making direct contact with the copper.

Regular 110 volt alternating current served as a current source

[2]Italics ours

and was led through two circuits, one containing a resistance of 925 ohms, the other a variable resistance of 1-65,000,000 ohms The constant resistance provided the unlearned stimulus and the variable resistance provided one of the acquired stimuli An audio-vibratory stimulus used as a second substitute stimulus was produced by an oscillator and amplifier which fed a loud speaker placed on the table back of the bowl [3]

The fish were tested once a day save during the retention periods and each fish was allowed sufficient time after being brought from the living bowl to the test bowl to become adjusted to the new situation Usually 5-10 minutes sufficed to produce a quiescent state Since the specific procedure varied in the different part of the experiment this is briefly mentioned for each part.

D. Method, Results

1. *Formation of Forward Conditioned Reflexes*

Forward conditioning was established by presenting the conditioned stimulus (weak shock or vibration) for three seconds and immediately following with a strong shock. Variable intervals, fluctuating up to 30 seconds around a 2-minute average, were allowed between successive trials This procedure was repeated 10 times per day From Day 2 on, the training period was preceded by five retention trials in which the conditioned stimulus alone was presented

Where shock was used as a conditioned stimulus in this test and in all subsequent tests a shock just strong enough to elicit pectoral fin movements was employed This was determined by starting with approximately 1,000,000 ohms resistance and then gradually decreasing the ohmage until pectoral fin movements appeared The ohmage was then increased and the point at which no movements appeared recorded The procedure was repeated 3-4 times, the fish were then isolated for 24 hours and the threshold previously found, checked. This was repeated for 5-10 days until a true threshold had been obtained

The response to the strong shock was a violent struggling or

[3]No attempt was made to determine whether or not the stimulus was a true auditory or vibratory stimulus, since this was not essential to the general plan of the experiment

flight response, and the conditioned responses to the conditioned stimuli *after* training were similar in form though usually of less intensity Every response was rated for intensity on a 5-point scale.

Conditioned responses were obtained in 11 fish In Tables 1 and 2 the following four measures are given (*a*) The number of trials

TABLE 1
FORWARD CONDITIONING IN 11 GOLDFISH
(*CS**—"liminal" shock, *US*—"strong" shock)

Fish No	Trials required 1st CR	Trials required Criterion	Trials before 100% retention	Maximum retention in days
1	2	46	60	7
2	16	88	110	7
3	8	20	50	7
4	21	49	50	7
5	15	36	70	7
6	13	27	40	7
7	15	38	90	7
30	7	26	100	16
31	8	29	70	16
32	4	16	40	16
33	9	27	60	16
	10 7	36 5	67.2	10 2

*Where abbreviations are used throughout this paper *CS* = conditioned stimulus, *US* = unconditioned stimulus, *CR* = conditioned response, *PCS* = pseudo-conditioned stimulus, and *PCR* = pseudo conditioned response

TABLE 2
FORWARD CONDITIONING IN 6 GOLDFISH
(*CS*—vibration, *US*—strong shock)

Fish No	Trials required 1st CR	Trials required Criterion	Trials before 100% retention	Maximum retention in days
11	9	27	70	14
12	14	68	120	14
13	5	19	60	7
14	28	57	80	7
15	17	79	90	3
16	41	88	100	7
	17.3	56 3	86 6	8 6

before the appearance of the first conditioned response, (*b*) the number of trials before the appearance of five conditioned responses in the 10 trials of a single test period, (*c*) the number of training

trials before obtaining 100 per cent retention for 24 hours (five conditioned responses in five trials) and (*d*) the maximum period of retention which was tested An arbitrary criterion of three conditioned responses in five trials was followed here

Forward conditioning was established in all fish tested and the speed of learning is in keeping with that found by other investigators (Sears, Froloff) both in the number of trials before a single conditioned response appeared and the number of trials before the response became stable and reliable. One characteristic deserves mention and this is the apparent non-specificity of the conditioned responses After training, any slight noise or jar served frequently to produce flight responses even though the true conditioned reflex was not presented. Furthermore, after training had been established the threshold for the *CS* of luminal shock became markedly lowered, as indicated by the fact that though many times the original amount of resistance might be used, a strong flight response would still be obtained

2. *Formation of Backward Conditioned Reflexes*

In the formation of backward conditioned reflexes the unconditioned stimulus of luminal shock was presented as soon as the fish had become quiet, usually in 20 to 30 seconds. The results of this test are presented in Table 3. Since the time interval varied from

TABLE 3
BACKWARD CONDITIONING IN GOLDFISH
(*CS*—"luminal" shock, *US*—strong shock)

Fish No	Trials required *1st C-R*	Trials required *Criterion*	Trials before 100% retention
20	5	115	140
21	6	134	140
22	12	128	130
23	9	91	140
	8 0	117 0	137 5

trial to trial and since it was always longer than for the forward conditioning, a control forward conditioning series was tested in which for every fish the time interval between presentation of the conditioned and unconditioned stimulus was matched for every trial These results are presented in Table 4

These results indicated that backward conditioned reflexes could

TABLE 4
CONTROLLED FORWARD CONDITIONING IN GOLDFISH
(*CS*—"liminal" shock, *US*—strong shock)

Fish No.	Trials required *1st C-R*	Trials required *Criterion*	Trials before *100% retention*
24	11	16	40
25	6	34	60
26	14	17	50
27	8	19	30
	9 7	24 0	45 0

apparently be formed but that they became stable only after a relatively long period of time. Since, however, Grether (4) had previously shown that backward conditioned reflexes in monkeys were in reality "pseudo-conditioned" reflexes the same control was run for the goldfish that had previously been run for the monkeys, the control being described below.

3. *Formation of "Pseudo-Conditioned" Reflexes*

Pseudo-conditioned reflexes were obtained by presenting the strong shock stimulus independently of any other stimulus 10 times a day at irregular intervals varying up to 30 seconds around a 2-minute standard The previously indifferent stimulus was then presented five times and the responses were noted From the second day on, the previously indifferent stimulus was presented for five trials (and, of course, never reenforced), 10 training trials were next given (the strong shock presented, but never paired with an *indifferent* stimulus), and then the originally indifferent stimulus was presented five times. All other criteria were the same as those used in the previously described forward conditioning experiments Two groups of four fish each were tested, the first group were "trained" individually, the second group were placed together in the bowl when the strong shocks were presented but *were* separated for the tests of responsiveness to the "liminal" shock. The results for these subjects are given in Tables 5 and 6

The results for pseudo-conditioning indicated that *the new stimulus-response connections were formed as rapidly without pairing of stimuli as they were with pairing of conditioned and unconditioned* stimuli. Furthermore, retention was at least as good for the pseudo-conditioned responses as for the conditioned responses.

TABLE 5

PSEUDO-CONDITIONING IN GOLDFISH, SUBJECTS TRAINED SEPARATELY
(Pseudo—*CS*—"liminal" shock, *US*—strong shock)

Fish No	Trials required *1st CR*	*Criterion*	Trials before 100% retention	Maximum retention in days
100	10	20	20	21
101	10	20	30	21
102	10	10	20	21
103	10	10	20	21
	10.0	15.0	27.5	21.0

TABLE 6

PSEUDO-CONDITIONING IN GOLDFISH, SUBJECTS TRAINED IN A GROUP
(Pseudo—*CS*—"liminal" shock, *US*—strong shock)

Fish No	Trials required *1st CR*	*Criterion*	Trials before 100% retention	Maximum retention in days
110	10	10	20	21
111	10	20	30	21
112	10	10	20	21
113	10	10	20	21
	10.0	12.5	20.0	21.0

Though not indicated in the two tables above a total of 40 strong shock trials were given From the 20th trial on the fish became extremely excitable and it was actually difficult to test for pseudo-conditioning. In all cases where tests could be carried out it was found that the limen to shock was greatly depressed and that the very weakest shocks almost invariably elicited a response Actually there was indication that the pseudo-conditioned responses were formed more rapidly than the conditioned responses and that the former were more reliable and were better retained

4. *Non-Specificity of Forward Conditioned Responses to Modality of the CS*

Non-specificity of forward conditioned responses was measured by first testing for limens to both shock and vibratory stimuli (No limen for the latter was found even when the amplifier produced a vibration of 128 dv/sec. at an amplitude of approximately 50 decibels.) Training for forward conditioning was then carried out,

the *CS* being a "liminal shock" and the *US* a strong shock. Non-specificity was tested by presenting a tone of 128 dv/sec with an intensity of about 30 decibels. Spread of conditioning from "liminal" shock to vibration (a different sense modality) is indicated in Table 7.

TABLE 7
SPREAD OF CONDITIONING FROM "LIMINAL" SHOCK TO AUDIO-VIBRATORY STIMULI

Fish No.	Trials for forward conditioning "*Liminal*" *shock* — *strong shock* *1st CR*	*Criterion*	Trials before responses to *audio-vibratory stimuli appeared* *1st CR*	*Criterion*
301	14	46	20	49
302	22	38	10	76
303	9	40	10	48
304	13	39	20	55
	14.5	40.8	22.5	57

5. *Non-Specificity of Pseudo-Conditioning to Other Modalities Than That of the US or Related "Liminal" Shock PCS*

To show non-specificity of pseudo-conditioning, limens to both shock and vibratory stimuli were first obtained, the results being the same as in Section 4 above. Ten strong shocks a day were then given to four fish for five days. At the end of each day's trials five "liminal" shocks and five auditory stimuli were presented. As is indicated in Table 8 non-specificity of pseudo-conditioning was clearly demonstrated; the new stimulus response capacities appeared early, were very consistent, and the responses were strong. Indeed, better pseudo-conditioned responses were obtained to the vibratory stimulus than to the "liminal" shock stimulus.

TABLE 8
NON-SPECIFICITY OF PSEUDO-CONDITIONING

Fish No	Trials before "pseudo-conditioned" responses appeared *To "liminal" shock* 1st PCR	Criterion	*To audio-vibratory stimulus* 1st PCR	Criterion
310	10	10	10	20
311	20	20	10	10
312	20	30	20	20
313	10	20	10	20
	15.0	20.0	12.5	17.5

6. *Non-Specificity of Environment in which Forward Conditioned Responses could be Elicited*

To determine whether or not the role of the training environment is a factor, determining or partially determining the elicitation of formed conditioned reflexes, audio-vibratory conditioned reflexes were set up in four goldfish in the training situation previously described After conditioned reflexes had been firmly established the conditioned stimulus was presented to the animals when they were in the "home" bowl both in the experimental and "home" room. These "home" bowls had been made as dissimilar to the experimental bowl as possible, being not only smaller in size but also ornamented with rocks and weeds In all cases conditioned responses were obtained, *no apparent difference being found between strength and* frequency in any of the situations

7. *Non-Specificity of the Environment as a Factor in the Elicitation of Pseudo-Conditioned Responses*

The effect of varying environments on pseudo-conditioned reflexes was also tested, the conditions being similar to those of Section 6 above, save for the fact that the unconditioned stimulus (shock) and the (audio-vibratory) pseudo-conditioned stimulus were never paired After pseudo-conditioned responses to audio-vibratory stimuli had been formed in four goldfish they could be elicited in either the experimental bowl or the "home" bowl and in either the experimental room or the "home" room with equal ease No distinguishing characteristics were observed In Grether's experiment on monkeys it should be noted the pseudo-conditioned responses were specific to the total training situation

E Summary and Conclusion

1. Both delayed and trace conditioned reflexes were established in the goldfish After being firmly established these responses were quite stable and could be retained for two weeks or longer

2 Backward conditioned responses were apparently firmly established in two or three times the number of trials necessary for the formation of the forward conditioned reflexes

3 Pseudo-conditioned reflexes, in which the unconditioned and "conditioned" stimuli were never paired were also formed in goldfish These reflexes were established as rapidly, if not more rapidly

than the true, forward conditioned responses. Pseudo-conditioned responses once firmly established were quite stable and were retained for at least three weeks, as long as or longer than the forward conditioned responses

4 Forward conditioned responses are not specific to the sensory modality of the conditioned stimulus. Thus after the formation of a conditioned response in which a "liminal" shock was associated with a strong shock, a previously inadequate audio-vibratory stimulus also elicited a response.

5 Pseudo-conditioning is not specific to the sensory modality of the unconditioned stimulus Thus after repeated strong shocks both previously inadequate "liminal" shocks and also audio-vibratory stimuli elicited pseudo-conditioned responses

6 After both conditioned and pseudo-conditioned responses have been formed they may be elicited in other environments than that of the environment in which the "learning" took place.

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THE TREATMENT OF ENURESIS BY THE CONDITIONED REACTION TECHNIQUE*

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Enuresis may be defined as the condition in which there is a lack of voluntary control of micturition after the age when the habit of voluntary control should have been established. Most writers agree that micturitional control should be learned not later than the third year after birth.

The number of children who, according to the three year standard, are enuretics varies with the reports of different investigators but, according to a summary of such studies by Louttit (1) about 15 to 20 per cent of children exhibit enuresis.

A host of factors have been blamed for enuresis. Some of the physical causes which have been cited are: anatomical anomalies, local irritations, chronic inflammatory processes of the internal urinary regions, glandular disturbances, diseases of the kidneys and urinary tract, abnormalities in the chemistry of the urine or in the amount of urine secreted, nutritional factors, diseases of the tonsils or adenoids, and diseases of the central nervous system. On the psychological side some of the causes named are: lack of proper training, the tendency of the child to sleep too soundly, fear, emotional instability, the sense of failure, lack of confidence, desire for attention, overdependence, jealousy, lack of intelligence, dreams, deliberate misconduct, and stubbornness.

The methods of treatment that have been prescribed are even more diverse than the causal factors which have been suggested. These include: (*a*) punishments, such as putting the offending child in a perambulator and parading him before his comrades as though he were a baby, or hanging up his wet bedding so that all the neighbors may see; (*b*) physical remedies, such as tonsilectomy, circumcision, distention of the bladder, nutritional treatments, and stretching the anal sphincter; (*c*) drugs, such as atrophine, thyroxin, pituitary extract, testicular extract, camphor, belladonna, and phenobarbital;

*Received in the Editorial Office on August 15, 1938.

(*d*) psychological remedies, such as making the child take responsibility for his own control, awarding stars on a chart for dry nights, giving the child suggestions, and getting the child up at regular intervals during the night; (*e*) miscellaneous remedies, such as restriction of the fluid intake especially before retiring, careful selection of diet, exercising control of the sphincter (by the start and stop technique as long as the urine lasts on any one micturition), injections of sterile solutions, keeping charts, avoidance of emotional excitement, change of environment, elevating the foot of the bed, placing a tightly rolled towel on the child so that he will be forced to lie on his side, and making the child sleep on a hard mattress.

Most of the theories and methods of treatment place the blame (either tacitly or openly) on the child himself This attitude tends to make the child develop a sense of guilt and is probably responsible for most of the conduct disorders and personality difficulties that are so often found to accompany enuresis Instead of blaming the child when he does not learn, it would seem wiser to blame our educational procedures A clear cut analysis of the learning problem involved should lead to the formulation of a more successful method of teaching the child than any of those methods mentioned above

Any analysis should state clearly just what the child should learn. Most of the earlier methods stressed the need for refraining from micturition for a longer or shorter period of time. The child was impressed with the fact that he must control himself. A little reflection will show that the objective of voluntary control and restraint is a fictitious objective It makes little difference how long an interval elapses between voidings One may urinate a dozen times a day and still keep dry, provided he urinates at the proper place The objective should be to teach the child to get up (or give the signal to someone else to get him up) and go to the urinal instead of wetting the bed Even if he has some physical condition which makes him want to urinate repeatedly, he should be able to learn to get up and go to the urinal

The training that the enuretic child needs has no immediate relation to the amount of urine passed, the number of urinations per unit of time, nor the time of day or night at which the urination occurs. Let us repeat, the only rational objective of the training is to teach the child to urinate in the proper place He should be taught to substitute the urinal for the bed as a place for his toilet activities.

Micturition in infancy and early childhood is a reflex process. The adequate stimulus for the opening of the sphincter is the pressure within the viscus. When this pressure is sufficiently relieved by micturition, another reflex process closes the sphincter Both are positive processes The cyclical characteristic of micturition comes about as follows The beginnings of tension in the bladder are not sufficient to cause an opening of the sphincter Instead, the tension must reach a certain threshold intensity before it become adequate to cause the reaction Having reached this point, there is a satisfaction of the need, followed by a relief from tension Thus there is a continual sequence of building up of tension, release by satisfaction of the need, and relaxation and relief from tension.

How is the child trained? Some writers maintain that he must be taught to substitute conscious control for this reflex act However, conscious control is a by-product of a training procedure which proceeds on a different basis It is failure to recognize this fact which leads to persistent enuresis If the first learning is not accomplished easily, the adult is baffled, places the blame on the child, urges him to control himself, and sets up unfortunate and fearful attitudes which complicate rather than help in the solution of the problem

The ordinary training process, by means of which the average child successfully learns the proper toilet habits, can be analyzed as a form of conditioned reaction learning. The procedure usually begins by observing the ordinary rhythm of the child so that a guess can be made as to the time intervals between actions Just before it would be normal for the regular cycle to end in a reflex discharge, the child is placed in a posture which facilitates discharge After a few trials the posture becomes a substitute stimulus for micturition in place of the visceral tension Having taught the child to urinate as a response to the posture, the parent or nurse may repeat some word each time after the process of urination has begun This word, after several repetitions in the proper manner, becomes a signal for the child to use In other words, the bladder tension results in the use of the learned signal word by the child instead of reflex micturition When the child is old enough to take care of himself, bladder tension leads to walking to the urinal without the use of any signal to another to help him

When a child is properly trained, bladder tension will lead to walking movements almost unconsciously, or to restlessness if he can-

not reach a toilet Any good mother knows the symptoms of bladder tension She may have a child out upon an expedition of some sort and notice that he becomes restless, standing first on one foot and then on the other The child himself may not be actually aware of his needs, but the observant mother senses them He has become so conditioned that the bladder tension stimulates him to incipient walking movements The important element in this learning is not that he has learned conscious self control, but that he has learned the substitute response of going to the toilet.

The same elements are involved in training the child to remain dry at night The child is taken up at some time during the night which will anticipate his action The proper training does not stress the need for refraining for urination through the night, but it does stress the substitution of a toilet action for bed wetting

Hence, it follows that if the enuretic child is to be cured the first step is to get a stimulus which is adequate to get him out of bed and start him for the toilet If this stimulus follows closely after the bladder tension, he can be taught to respond to the bladder tension by rising A gong was selected as a stimulus and signal for going to the toilet

The apparatus used to accomplish this purpose is very simple. Under the child is placed a pad which is wired in such a manner that moisture will close an electric circuit, which, in turn, sets off a loud bell or a buzzer

The arrangement of the pad and the wiring is illustrated in the diagram (Figure 1) The pad is made up of three thicknesses of cloth, two of which are wired and one left plain The cloth may be muslin, Indian head, soft cotton, or linen: some fabric that will readily absorb moisture The upper and lower layers are threaded with number 30 B & S guage bare copper wire. The wires in each of the upper and lower layers are threaded in parallel lines about an inch apart and all the wires in one layer are attached to a single lead-off wire The three pieces of cloth are then placed together in such a manner that the plain layer lies between the two wired layers Furthermore, the wires in the top layer are arranged at right angles to those in the lower layer so that there will be a great number of points where the wires of the upper and lower layer will be separated only by the insulating middle layer. As soon as the middle layer becomes moist a contact will be formed between the top and bottom

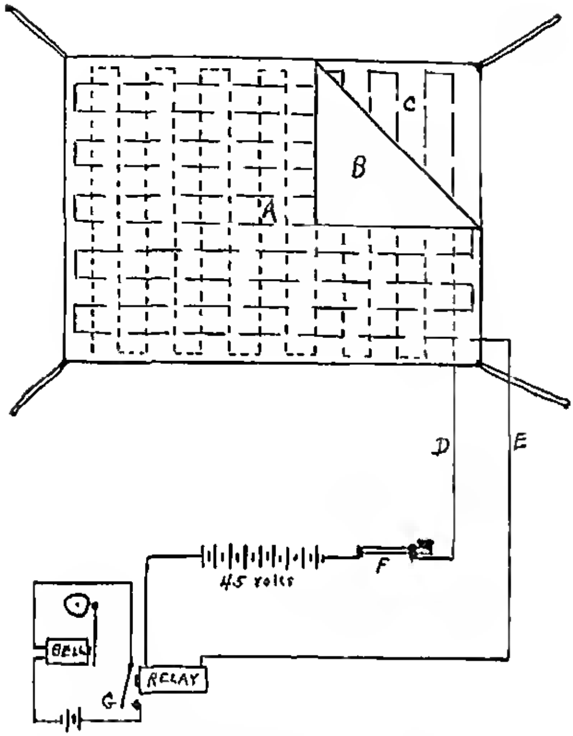

FIGURE 1

DIAGRAM OF ENURESIS PAD AND CONNECTIONS

The top layer of the pad (*A*) shows the wires running horizontally. The middle layer of the pad, without wires, is shown folded back at *B*. The bottom layer, with wires running vertically, is shown at *C*. The wire from the bottom layer leads off from the pad at *D* to the switch *F*, then through the 45 volt B-battery to the relay, returning through *E* to the lead-off wire to the top layer of the pad. When a connection is made from the top to the bottom layer of the pad, by means of moisture, the relay is operated, closing the independent circuit at *G* and ringing the bell. The pad is tied to the bed by means of the tapes extending from the four corners.

layers. The two lead-off wires from the pad are connected with a relay through a 45 volt B-battery. This relay operates a bell circuit.

The only precautions needed in setting the pad for the night were to make sure that the pad was fastened securely, that it was dry, and that the connections were all good. Usually the batteries and bell were placed beneath the child's bed.

The instructions given to each child were kept very simple. It was calmly explained that the apparatus was merely a device to help him wake up and go to the bathroom when he had to urinate. He was told that when he started to urinate the bell would ring and that, when he heard this bell, he should get up immediately, throw the switch to stop the bell, and go to the bathroom. He should go to the bathroom, even though he might think he had finished urinating, and see that his bladder was as empty as he could make it. Then he should come back, remove the wet pad and replace it with a dry one, connect it and go to bed again. If the child was too small to make the connections himself, a nurse or attendant did this for him.

Five cases of chronic enuresis were used in the original experiment. Four of them responded readily and learned to get up and go to the toilet in place of urinating in the bed. One subject learned after five trials, the second after four, the third after six, the fourth learned partially after five trials, but required fourteen for complete learning. The fifth child was found, after a brief trial, to have bladder trouble which required medical care. He was removed from the home where the experiment was conducted and no further opportunity was given to give him further training.

While the number of subjects were few, the fact that all except one, and that one a pathological case, responded so readily to treatment, is strong confirmation of the soundness of this method of education. The primary purpose of this paper is to indicate the theoretical soundness of the principles involved.

Since the inadequate stimulus should precede the conditioned stimulus, our experiment is ideal for establishing a conditioned reaction. The bladder tension always preceded the ringing of the bell but by short enough interval for the child to learn to respond to the internal stimuli without waiting to hear the bell ring.

One interesting tendency noted among the children given this training was the general improvement in their personality and behavior. One subject became neater in her dress and appearance. Another was more eager to enter social activities and games. Another became much more responsible in his attitude. Another was reported to have become more self-reliant and eager to do things for himself.

These changes in personality characteristics suggest that the symptomatic behavior so often found in enuretics is a secondary result of wrong training. No attempt was made to correct personality peculiar-

ities in this experiment. Enuresis was merely regarded as a habit which could easily be replaced by another habit.

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The Journal of Genetic Psychology, 1939, 55, 67-80

A STUDY OF THE DEVELOPMENT OF THE AIR-RIGHTING REFLEX IN CATS AND RABBITS*[1]

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One of the present writers has presented a note reporting the history of the study of the air-righting response in cats and also giving some preliminary data upon the development of this response in ontogeny. The reader is referred to that paper (1) for introductory details.

In the present paper, a report is presented of an experimental study of the development of the capacity in young cats and rabbits to turn in the air and land on their feet when dropped from an inverted position. The relationship between the development of this response and the growth of the functional visual mechanism is described. An incidental note on the development of this response in young guinea-pigs is also presented.

A standard procedure was used in the present study. The animals were suspended upside-down in a specially constructed double clamp apparatus which allowed all four legs to be released simultaneously. Figure 1 shows a diagram of this apparatus. The brief study referred to above had demonstrated that it was virtually impossible to hold and release the animals satisfactorily by merely grasping the legs with both hands. In the present apparatus, padded jaws were provided, arranged in such a way that the front legs were held in one clamp and the hind legs in another. When inserting an animal into this holder, the experimenter held the animal's legs up into the jaws. The experimenter then put his foot on the lower pedal which allowed a tension, sufficient to hold the legs, to be exerted on the jaws of both clamps. When the animal was to be released for experimental study, it was then only necessary to give a short pull on the trip-cord, and all four legs were simultaneously and completely freed from support, thus starting the animal's fall. This apparatus proved

*Received in the Editorial Office on August 27, 1938.

[1]These experiments were conducted in the Laboratory of Psychology of the University of Rochester.

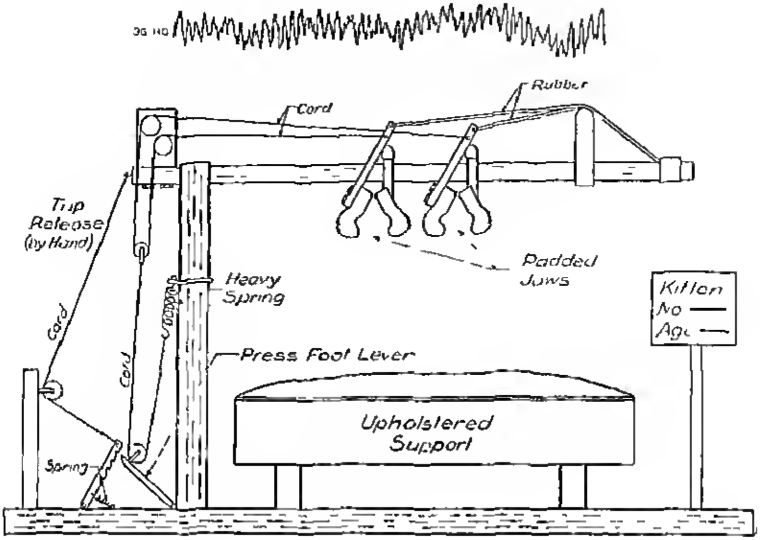


FIGURE 1

very satisfactory. It can be used by one experimenter working alone.

In addition to careful observations of the air-righting behavior of the animals noted above, motion pictures were also taken of the response. In making these pictures, a Cine Kodak Special 16 mm. Camera was used, set to 64 frames a second, the shutter at the same time being set at one-quarter normal opening, employing a lens stop of *f* 1 9 and three 1000-watt lamps for illumination. The camera was always at a constant distance from the animal. This procedure gave clear pictures, most effectively arresting the movements of the falling animals The animals reported upon here were photographed during from one to three drops each day Careful nonphotographic supplementary records, based upon direct observation, were made of 10 additional drops per day of each animal. Daily weight records were also kept of all animals, and simultaneous observations on the development of visual function were made as described below.

In the analysis of the moving-picture records, the first indication of any beginning of the true righting response was considered to be that drop in which the animal gave a clear-cut turning reaction of

its head after it had fallen clear of the restraining jaws, followed by at least a slight twist of the entire brachial region. In direct, non-photographic observations of air-righting, the first evidence of righting which could be noted was taken to be a landing of the animal in a position so that the head and shoulders were turned about the horizontal axis to the extent of at least 180 degrees, while the pelvic region remained definitely retarded *in this twisting movement*. These criteria were based on the analysis of the air-righting reaction previously reported (1).

The first good righting (or "100% righting") as analyzed from the motion-picture films was that in which the animal's body had already assumed the normal right-side up position and showed no significant twist out of this position at the time when it touched the pillow, and further, that all four legs made a relatively simultaneous contact with the pillow. In the case of non-photographic observations at the time of dropping, such a perfect landing was inferred if the animal did not need to make any body adjustments after arriving on the pillow.

Finally, an effort was made in the cinematographic analyses to determine the movement sequences by means of which an animal can so rapidly turn its body completely around in air. The standard drop of 30 cm. used in this experiment takes only about one-quarter of a second. The method of analyzing the responses involved in air-righting was to project the frames one at a time, and then to trace the gross outlines of the animal in its various positions during the 30 cm. fall.

Experiments with Kittens

Ten kittens taken from four different litters were dropped 10 times daily, beginning the first day after birth. It was found that during the first four weeks of life, the kittens usually did not turn over during their fall through the air, but landed flat on their backs. A summary of the time required at different ages to right on the pillow is given for the ten kittens in Table 1. This response, while not an air-righting response, is, as suggested in the work of Coronios (2), Windle and Griffin (8), and one of the present writers (1), probably to be considered as at least one of the precursors of the capacity to right in air. The letters on the left margin in the table identify the four litters. Each figure in the table itself indicates

TABLE 1

KITTEN RIGHTING ON A SUPPORT

Ages are given in days. Figures in the table itself refer to time in seconds which is required for animals to right themselves on the pillow support after falling on their backs.

Animals	Ages 1-5	Ages 6-10	Ages 11-15	Ages 16-20	Ages 21-25	Ages 26-30
Ad—1	2.5	2.6	1.5	1.0	0.8	0.6
2	2.3	2.1	1.5	0.8	0.6	0.5
Db—1	2.5	2.4				
Ha—1	2.2	2.2	1.6	1.5	1.1	
3	2.3	2.0	1.4			
4	2.0	2.0				
5.	3.0	2.6	2.5	2.4	1.7	
Ja—1	1.7	1.5	1.3			
2.	2.0	1.7	1.4	1.2		
4	1.8	1.7	1.6	1.1		

the *average time in seconds needed by any one animal* to make a single righting response on the pillow support. Unfortunately, it was impossible to complete the study of all the animals because certain individual animals were sacrificed for future neurohistological study.

Table 1 demonstrates that in kittens from 1 to 30 days of age, there is a gradual but definite decrease in the time necessary for righting after the animal has landed on a support in an inverted position. During the period *from 1 to 5 days*, the average time for righting of this sort was 2.2 seconds for each response, at 6 to 10 days, the average time was 2.1 seconds. At the age of about 12 days, kittens usually begin to show a marked increase in neuromuscular coördination, and consequently, at ages between 11 and 15 days, the time for a righting response is only 1.6 seconds on the average. At ages 16 to 20 days, the time is 1.3 seconds, and at the ages of 21 to 25 days, the average time for righting is 1.1 seconds. By the age of 30 days, the kittens either *right as they fall* through the air, or turn over immediately after landing on their backs, as indicated by the average of righting time of 0.6 seconds.

As this gradual increase in agility of righting on a support develops, therefore, the kittens now and then *give evidence* of the first beginning of some incipient righting responses even a little before actually landing on the pillow. Very gradually, these incom-

plete righting responses become more rapid, until the animal rights completely in air. The first evidence of the beginning of such air-righting is seen at the average age of about 23½ days.

Table 2 shows the ages at which air-righting was first seen to be-

TABLE 2

KITTEN RIGHTING FALLING REFLEX, OR AIR-RIGHTING, AS OBSERVED DIRECTLY AND ALSO AS STUDIED BY MOVING-PICTURE ANALYSIS

Figures in the table indicate ages in days when the respective criteria of performance were reached (10 drops per day)

Animals	Age at first evid. of righting	70% good righting	100% good righting	*Analyzed from the movies* first evid. of righting	Good righting
Ac—1	21	29	33		
2	21	36	48		
3	21	30	37		
Ad—1	27	—	44	28	45
2	27	—	38	24	44
Ha—1	25	—	—	28	
5	28	—	—	23	
Ja—1.	21	—	—	21	
4.	21	—	—	20	

gin, in the data column on the left. As seen in the adjoining column to the right, 70 per cent good righting (i.e., seven good landings in 10 drops) was observed at the age of about 31½ days. By the average age of 40 days, the kittens for the first time succeeded in landing squarely with all four feet during 10 successive drops. However, even after this age, there were occasions when the kittens failed to make a righting response. By the age of 60 days, they still did not right themselves in air nearly so regularly as does an adult cat.

On the right side of Table 2, there are also results derived from the analysis of motion-picture film. For this purpose, animals were photographed during at least one drop per day under conditions described above. A study of these films brought out the fact that even responses which at the time looked like perfect righting to the observer may actually not have been quite complete. However, there is no marked difference between the results of motion-picture analysis and the ages at which 10 seemingly perfect drops were executed by the animals on any one day.

It is interesting to consider the temporal relationship between the

appearance of air-righting and the development of functional visual capacities in the same animals. During the course of the air-righting studies, an attempt was made to blindfold the animals, and in this way impair the righting response. This effort gave entirely negative results, the kittens righting as well when blindfolded as they did normally, no matter at what stage of development the blind was tried.

However, it is possible to indicate a temporal relationship between the attainment of good visual acuity and the appearance of first beginnings of air-righting. The method of determining the visual acuity of young mammals has been reported in detail (7). This method depends on the fact that most animals will "pursue" with head and eye movements the progression or movement of any gross visual pattern in the immediate environment. This response was

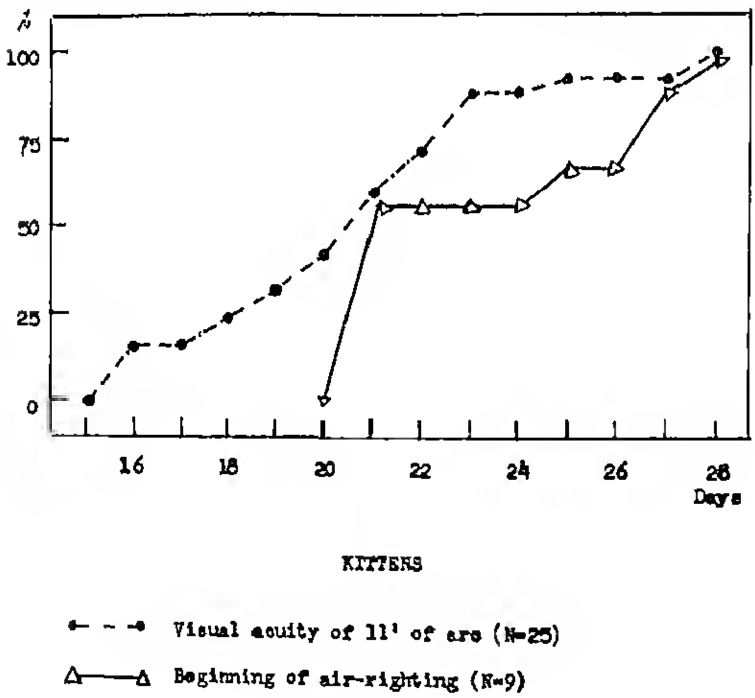
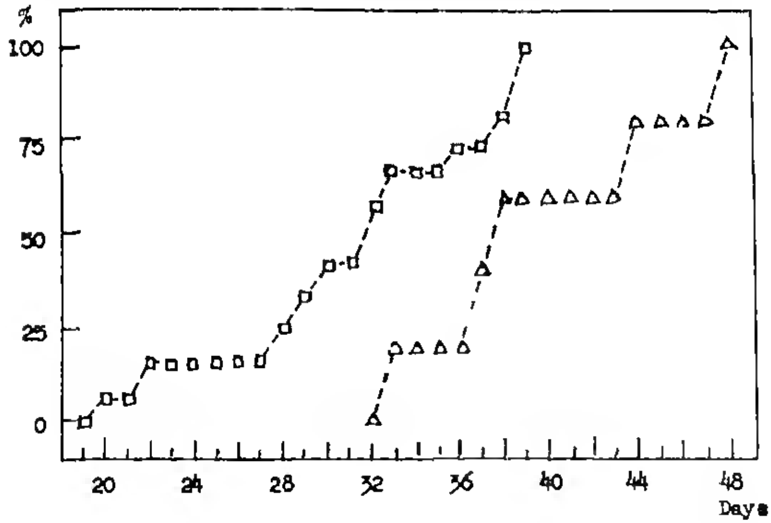


FIGURE 2

utilized under laboratory conditions The young animals were placed on a very small stationary platform located on the brightly illuminated interior of a larger revolving cylinder The cylinder stood upright and carried black and white paper stripes on its inner surface These stripes were all of the same width at all times, but this width of all the stripes could be varied so as to present a very gross or a very fine pattern The visual angles subtended for the experimental animals by the stripes, which served as the basis of visual acuity determinations could be changed from 720′ of arc to 360′, 180′, 90′, 43′, and 11′ of arc. The finest stripes to which responses could be elicited are taken as representing an animal's visual acuity Various temporal correlations between different increments of development could thus be drawn. This has been done for example in Figure 2, where the dotted-line curve at the left represents ages at



KITTENS

□– – – –□ All lens vessels gone (rear vessels) (N=18)

△– – – –△ 100% good air-righting (N=5)

FIGURE 3

which a visual acuity of 11′ was shown by 25 kittens, while the solid-line curve with triangles delineates the ages at which air-righting could first be seen to begin. The median ages for these two types of growth changes are quite similar, the median being 20 days for a visual acuity of 11′ and the median age for the beginning of air-righting being 21 days. This graph and Figures 3 and 4 are percentile graphs. The percentiles are marked off on the vertical axis on the left of each graph. The base line indicates age in days as shown on the graphs.

The rather late appearance of 100 per cent good righting is presented in Figure 3. The curve at the left with white squares stands

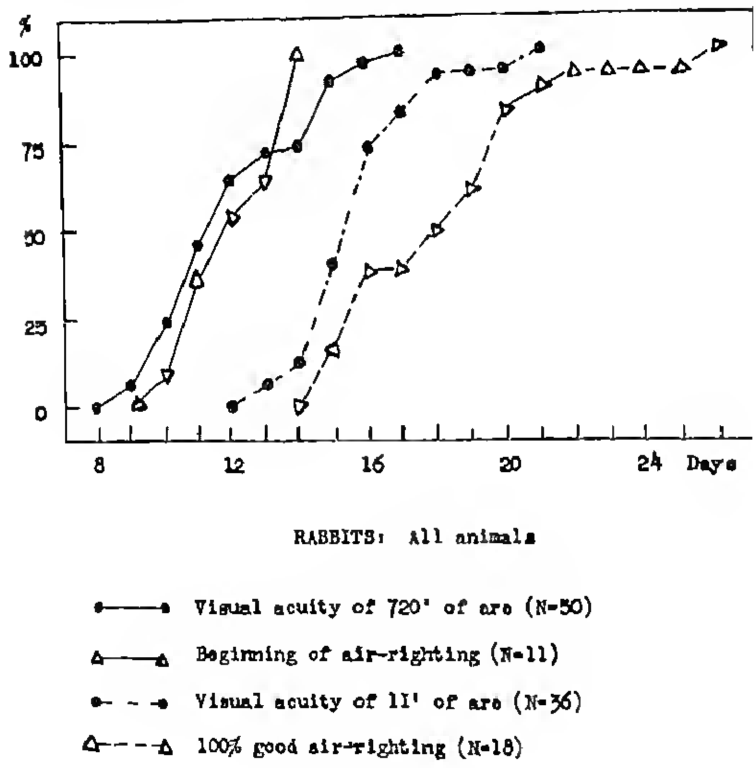


FIGURE 4

for the ages at which all lens blood vessels were completely gone in 18 kittens. The disappearance of blood vessels from the lenses of young mammals has been previously studied as a stage in visual development and has been reported earlier (7). The curve at the right with triangles indicates the ages at which five kittens showed 100 per cent good righting. The medians for these two developmental increments are seven days apart, and the curve of lens clearing is included simply for the sake of temporal orientation.

The conclusion may be drawn from the data presented above that air-righting in kittens is not primarily a visually controlled reaction in these animals, although the temporal relation to good visual acuity suggests that vision may have some facilitating effect.

Experiments with Rabbits

The appearance of the air-righting reflex was studied in 18 young rabbits, including both pigmented and albino animals. The problem setting was analogous to that just described for kittens. Again each animal was dropped 10 times daily. Cinematographic records were taken of some of these animals as in the case of the kitten-falling experiment. The observational data on rabbits are presented in Table 3. Reference to this table will show that in the rabbits studied, the first evidence of air-righting appeared at ages ranging from 10 to 14 days, while 100 per cent good righting appeared at ages ranging from 15 to 26 days. The table further shows that apparently the gestation period of the animals does not have as much influence on the age of air-righting as do other presumably hereditary determinants, the latter fact being indicated by litter comparisons. A preliminary hypothesis that body weight might be important as a determinant of age of air-righting is probably made unlikely by the study of the weights given in the column to the right, which gives the weight in grams of each animal at the typical age of 12 days. Weights at other ages confirm this observation (7).

The relation between the growth of air-righting and the growth of visual acuity is shown in Figure 4. The two curves with black dots represent visual acuities of 720′ and 11′ respectively, from left to right. The two curves with triangles represent air-righting, the solid-line curve indicating ages at which the first beginnings of air-righting were noticed, and the broken-line curve delineating ages at which 100 per cent good righting could first be observed. It is interesting

TABLE 3

AIR-RIGHTING IN RABBITS AS OBSERVED DIRECTLY

The figures in the table indicate ages in days when the respective criteria of performance were reached (10 drops per day) The weights at the age of 12 days, and the gestation periods, are separately indicated

Animals	Age at first evid of righting	70% good righting	100% good righting	Weight in gm at age of 12 days
Na—3	14	16	21	188
5	—	18	20	162
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

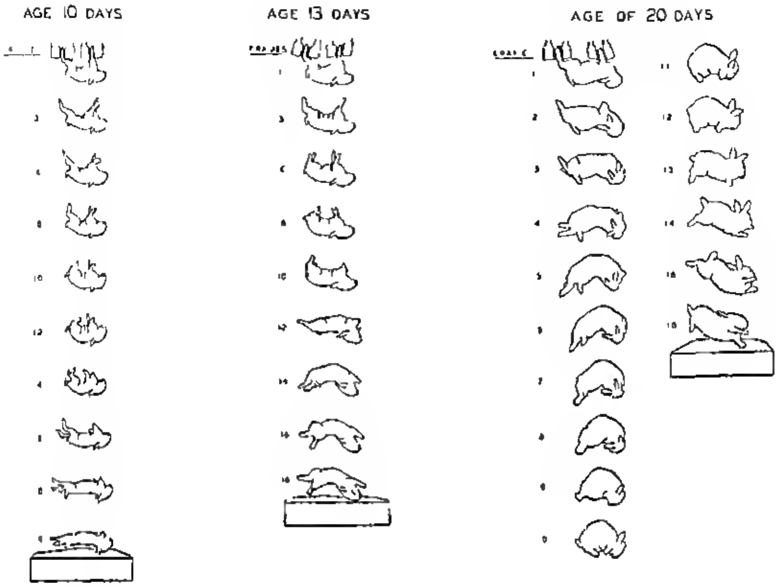


FIGURE 5

Diagrams of movement sequences during falling in a young rabbit at three different ages, 10 days, 13 days, and 20 days Not every frame is shown The frames represented are numbered at the left of each diagram, the numbering for each falling sequence beginning with "Frame No 1" as the last frame before the jaws opened. Since the film was photographed at the rate of 64 frames per second, and the exposure per frame was about 2 sigma, the time interval from one frame to the next was roughly 15 sigma All the diagrams are drawn to the same scale, hence the animal is larger at the later ages because of normal gain in size and weight during the days represented

righting response This figure may be taken as typical of many hundreds of photographed sequences prepared in this study. It should be emphasized that the responses shown in this diagram are typical but that there are many minor variations in other sequences which might have been selected for presentation The pattern of air-righting in the case of kittens is in certain minor respects different from that shown here for the rabbit

The exact movement sequences which the animals perform as they fall through the air during approximately one-quarter second are of

interest in several respects. The problem of just how an animal can turn its body completely over in air without any previous impetus to do this trick has long been puzzling. In this connection, the very fast reaction time is of interest, and the question of how this very complex reflex or succession of reflexes is initiated so rapidly upon release of the animal may justify detailed study. Finally, to the knowledge of the writers, this report constitutes the first presentation of diagrams to illustrate the nature of the genetic development of the air-righting response in young mammals.

Diagrams such as Figure 5 were secured by tracing the individual frames of motion-picture film taken at the rate of 64 frames per second. Three ages were arbitrarily chosen as representative of certain stages in air-righting development in the particular rabbit pictured here: 10 days, when no air-righting could be detected; 13 days, when there was some indication of air-righting; and 20 days, when this rabbit righted perfectly in air. It will be seen that approximately 18 to 20 frames show the complete sequence of events, beginning with "Frame 1" as the one before the apparatus jaws opened and ending with "Frame 18" or whatever the last frame is as the one where the rabbit lands on the pillow support. Not all frames are depicted in each of the three sequences, and the frames shown are numbered to the left of each diagram. Knowing the speed of the film and the number of the frames, it is possible to compute the time elapsing between different aspects of the air-righting sequence.

In a rather general way, with the temporal element very roughly indicated, these sequences may be described in the following manner. At the age of 10 days, no air-righting at all is observed. After the apparatus jaws open suddenly and release the animal, the animal seems to show a definite body extension. Within about 90 sigma, this initial extension gives way to a flexion of the entire body, lasting for about 100 sigma. Then follows another extension which continues for the remainder of the drop. Through most of this drop, the animal's body forms somewhat of a "crescent" with the concave side up.

At the age of 13 days, this rabbit shows a pattern of movements very similar to those at 10 days, but now some slight turning occurs during the drop through the air. Immediately after being released from the apparatus, the animal now shows an extension of the body

for about 70 sigma, then a flexion for about 70 sigma, then an extension which continues for the remainder of the drop. It is probably significant that in the course of this extension the animal's body again forms a kind of "crescent," this time with the concavity downwards It seems that the first appearance of air-righting is associated with this assumption of a crescent with concave side down In this particular drop, the animal is turning toward the right The fore part of the body is the first to turn, then it seems to turn back slightly while the hind legs are turned toward the right At this point in the sequence the animal lands As yet, the movements involved in righting occur only after considerable initial latency compared with the speed of reaction at later ages

When the particular animal pictured here was 20 days old, it gave a perfect righting response in about 200 sigma The animal turned over toward the right, and the sequence of movements was somewhat as follows First there occurs a turn of the head to the right and a general body extension followed by a turn of the shoulder girdle to the right and an extensor arching of the back. Then, while the back arches yet more, the fore-feet and head turn somewhat back to the left as the hind-feet turn to the right This brings the body into a lateral position, and both the fore and hind parts of the body turn definitely down so that the animal's shape clearly resembles a half moon with the concavity downwards. Following the previous extension of the legs, there is now beginning a complete flexion The front legs are flexed first, then the head is moved toward the chest, following which the hind legs are flexed By this time the animal is turned entirely right-side up, and the remainder of the drop is marked by a general extension again By the time the animal lands, it has even "overshot" somewhat, and is a little more than completely turned around Summarizing this particular drop as was done with the others, it is found that the initial extension lasted for only about 40 sigma, the consequent flexion of the body took about 140 sigma (during which almost all the righting occurred), and the final extension continued for the rest of the time

It is perhaps of some interest that in all these sequences, some of the same basic movement elements appear: There is first an initial extension, then a general body flexion, followed by another body extension One notable difference between the non-righting and the righting stage might be that before the animal rights in air, its body

forms a crescent with the concavity upward, while after air-righting has appeared, the body of the animal forms a crescent with the concavity downward during the drop

It may be noted here as a result of some preliminary observations that apparently there is great variability in the time of the development of the air-righting response in newborn guinea-pigs. In certain animals, the capacity seemed to be present on the first day of birth; in others, the response did not develop to its maximal form until much later.

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The Journal of Genetic Psychology, 1939, 55, 81-101

EXPRESSED WISHES OF ELDERLY PERSONS, COLLEGE MEN, AND BIRTHDAY WISHES OF FIRST GRADE CHILDREN*[1]

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The studies reported herein are, in themselves, quite inadequate, but offer interesting comparisons with data already published regarding wishes of students and children (1, 3).

A Wishes of Elderly Persons

Two groups of men and women contributed to this part of the report One was a group of 55 persons ranging in age from 65 to 75 years, called the *charity* group because all were recipients of governmental relief This relief was very small, being granted for necessities only They all lived in the same neighborhood in Brooklyn, New York, and may be described as follows Men 31, women 24; white 52, negro 3, Jewish 36, German 7, Irish 6, African 3, English 2, Scotch 1, married 31, widowed 21, separated 1, single 2

The other group was composed of 48 people, living in four homes for the aged, and called the *paying* group because each had paid fees ranging from $300 to $600 for permanent residence in the homes They had been required, also, to furnish character references This group may be described as follows Men 15, women 33, white, all, American 46, English 2, married 20, widowed 6, single 22, Episcopalian 31, Presbyterian 5, Methodist 4, Lutheran 8. Ages ranged from 60 to 96 years

A considerable degree of quality of difference distinguished the two groups In a general way the charity group was financially poor and probably culturally and socially under-privileged, doubt-

*Received in the Editorial Office on August 27, 1938

[1]Parts 1 and 2 of the study were made possible through the efforts of students in two classes in social psychology in the evening sessions of Hunter College, New York City Part 3 was made available through the courtesy of Miss Agnes Burke, teacher of Grade 1, Horace Mann School

Prepared with the assistance of U S W P A Project No 65-97-295, Sub 25

less a life-long condition for most of them. The preponderance of Jewish faith was also found in this group only. The age range was much smaller for this group than for the other The paying group was perhaps more homogeneous than the other except in age. All were Protestants, all but two Americans and most important of all, all came from the more favored socio-economic levels of the New York population Because of the marked differences in the two groups the data for each are given separately as well as being combined

The procedure for gathering the information was substantially the same as that used in the former studies Each person expressed first, second, and third wishes which he or she would like most to have realized. These wishes were then classified according to Jersild's categories, except that an additional heading was provided, No *XXII, Special Future Benefits for Self.*

TABLE 1
DETAILED WISHES OF ELDERLY GROUPS

	Order of Wishes							
	1st		2nd		3rd		Total	
	Pg.	Ch	Pg	Ch	Pg	Ch	Pg	Ch *
I—*Specific material objects and possessions*								
1 toys								
p 2 clothes		3						3
p 3. food (1), cigars (5)		6						6
u 4 small boat, automobile	1	2	1		2		4	2
u 5. permitted to have a cat					1		1	
u 6 nice summer home, home in country	1		1		1		3	
u live in country, in mts	1				1		2	
u cottage near seashore			1				1	
u garden of own, money for farm			1		1		2	
Totals							13	11
Per cent							9 1	6 7
II—*Money and wealth*								
u 7 money			1	14		17	1	31
8. wealth								
u have good income, financial independence	1		2				3	
Totals							4	31
Per cent							2 8	18 8

TABLE 1 (*continued*)

		Order of Wishes							
		1st		2nd		3rd		Total	
		Pg	Ch	Pg	Ch	Pg	Ch	Pg	Ch *
III—*Good living quarters*									
u 9	better home		3						3
u	home of my own			1				1	
	Totals							1	3
	Per cent							0 7	1 8
IV—*Activities, sports, diversions*									
u10	good library, large library			1		2		3	
11	sports								
p12.	victrola, movies		2						2
p	radio		1			1		1	1
p	theatre		4						4
u	season pass to opera	1						1	
p	entertainment				1		4		5
u13	vacation in south		1						1
u14	travel				2		2		4
u	travel U S		1			2		2	1
u	travel in Europe, England, world	3				1		4	
u	live abroad, England					2		2	
15	occasions								
16	parties								
17.	tasks and undertakings								
	Totals							13	18
	Per cent							9 1	10 9
V—*Opportunities and accomplishments*									
18	specific educ (exec music)								
19	music								
20	personal accomplishments								
u	sell my book, play, invention					3		3	
	Total							3	0
	Per cent							2 1	0
VI—*Have a vocation*									
u22.	teacher (2), priest (1)		3						3
23	be big, independent								
	Total							0	3
	Per cent							0	1 8

*Pg =Paying group
Ch =Charity group

TABLE 1 (*continued*)

	Order of Wishes							
	1st		2nd		3rd		Total	
	Pg	Ch	Pg	Ch	Pg	Ch	Pg	Ch *
VII—*Be bright*								
24 intelligent							0	0
VIII—*Moral self-improvement*								
25 personality, poise, etc.							0	0
IX—*Improved personal appearance*								
i26 *young and pretty again*	1						1	
Per cent							0.7	0
X—*Prestige, adventure*								
u27 prestige				1		2		3
t be actress, singer		2						2
Total							0	5
Per cent							0	3.0
XI—*Supernatural power*								
29 magic powers							0	0
XII—*Have baby, sibling*								
i30. son, adopted child as	1						1	
husband desired	1						1	
Total							2	0
Per cent							1.4	0
XIII—*To be married*								
u31 be married, remarried		4	2	1		1	2	6
32 love and be loved								
Total							2	6
Per cent							1.4	3.6
XIV *Relatives never die*								
i33 wife never die					1		1	
t daughter, relatives alive	2				3		5	
Total							6	0
Per cent							4.2	0
XV—*Companionship*								
p34 companionship		2		10		8		20
p35 more friends, more companionship			3		1		4	
p better social life			1				1	
Total							5	20
Per cent							3.5	12.1

TABLE 1 (*continued*)

		Order of Wishes							
		1st		2nd		3rd		Total	
		Pg	Ch	Pg	Ch	Pg	Ch	Pg	Ch *
XVI—*Relief from irritations*, etc									
36	relief from duties								
u37	physical pain	1				1		2	
38.	imaginary conditions								
	Total							2	0
	Per cent							1 +	0
XVII—*Specific benefits, parents and relatives*									
u	help Gracie		1						1
p39	welfare of children, grandchildren		1		5		8		14
u	money for relatives	1		4				5	
40	releases								
	Total							5	15
	Per cent							3 5	9 1
XVIII—*General inclusive benefits - for self*									
41.	general benefits								
p	always do God's will			2				2	
p42	health, happiness, health & happiness, etc		14		17		9		40
p	health for myself, good health, etc	6		4				10	
i	health remain as it is for next 20 years	1						1	
i	never get feeble	1						1	
i	live forever	1		1				2	
p	don't become blind	1						1	
p	not die for 10 years			1				1	
p	always be as happy	1						1	
p	peace of mind, peace		3			1	4	1	7
p	happiness rest of life			1				1	
u	living with family again			1				1	
p	always be loved by those close to me					1		1	
u	were not in a home					2		2	
	Total							25	47
	Per cent							17 +	28 5
XIX—*General communities for self*									
43	remove all obstacles								
44	never be poor								
	Total							0	0

TABLE 1 (*continued*)

		Order of Wishes							
		1st		2nd		3rd		Total	
		Pg.	Ch	Pg	Ch	Pg	Ch	Pg	Ch *
XX—*General benefits for relatives*									
p45	health for sister, family	2				1		3	
p	health for husband, self	1						1	
p	gen'l benefits for fam, rel.			1		1		2	
u	health for son		2						2
	Total							6	2
	Per cent							4.2	1.2
XXI—*General benefits for others, philanthropic, etc.*									
46	release from bad people								
47	gen'l benefits to others								
u	achieve something to benefit mankind	1						1	
i	eternal life	1						1	
i	world without sickness	1						1	
u	more opportunity to do good			2				2	
u48	help others less fortunate			3				3	
u	more money with which to help people					1		1	
p	*education of the masses*					1		1	
u49	end of war				3	4		4	3
p	end of depression					1		1	
	Total							15	3
	Per cent							10.5	1.8
XXII—*Special future benefits for self*									
i50	live life, youth over again	3		2	1			5	1
i	were 20 again					1		1	
i	had married, had family			1				1	
i	eternal youth			1				1	
i	had traveled when younger					1		1	
p51.	easy death	2		2		3		7	
p	die soon	2						2	
p	die in sleep	2				1		3	
p	don't die of heart attack	2						2	
p	Overture to Tannhauser be played at my funeral			1				1	
p	won't die before I finish my story			1				1	

TABLE 1 (*continued*)

		Order of Wishes 1st Pg	1st Ch	2nd Pg	2nd Ch	3rd Pg	3rd Ch	Total Pg.	Total Ch*
p52	die & join dear husband, see dear ones in Heaven	2				1		3	
p	meet my Maker today	1						1	
u	be alive when Christ comes to earth again	1						1	
p	go to heaven			2		1		3	
p	know my relatives in Heaven			1				1	
u	wife, husband & I die together			2		1		3	
u	never live to see wife die					1		1	
p	be buried with mother					1		1	
p	some of family with me when I die					1		1	
	Total							40	1
	Per cent							28 0	0 6
	Grand Totals	47	55	48	55	48	55	143	165
	Total per cent							100 3	99 9

Two comparative tables present the classifications of the wishes of these elderly groups Table 1 shows in detail the three wishes of each group according to the complete classification. Unfortunately only the first wishes of the charity group can be given in full detail, since the reporter for that group gave the second and third wishes by main classifications rather than separately This accounts for the larger numbers in Table 1 for the 2nd and 3rd wishes of the charity group The first wishes of this group, however, and all the wishes of the other group are given in full detail. The wording in the table preserves the essential ideas and frequently the peculiar expressions of the subjects in specific and qualitative ways which are lost in the main categories For example, under Heading *I, Specific Material Objects and Possessions* the table shows that three of the paying group wished, respectively, for a small boat, summer and country homes, while of the charity group 3 desired clothes, 1 food, 5 cigars, and 2 automobiles, before anything else

The table also gives the percentages of each group's wishes for the 22 main categories in terms of the total number of wishes made by each From these percentages the following comparisons may be made

1—The charity group expressed more wishes for		
XVIII, general benefits for self	28 5%	charity
	17 7%	paying
XV, *companionship*	12 1%	charity
	3 5%	paying
XVII, specific benefits to relatives	9 1%	charity
	3 5%	paying
IV, 12 entertainment, radio, etc	7 3%	charity
	1 4%	paying
I, specific material objects and possessions (as shown by first wishes, which only were given for the charity group)	20%	charity
	6%	paying
2—The paying group expressed more wishes for		
XXII, special future benefits for self	28 0%	paying
	0 6%	charity
XXI, philanthropic, etc	10 5%	paying
	1 8%	charity
XX, general *benefits to relatives*	4 2%	*paying*
	1 2%	charity
XIV, children and other deceased relatives living	4 2%	paying
	0 0%	charity
IV, 10 books	2 0%	paying
	0 0%	charity

The charity group seems to have been characterized by special interests in immediate concrete benefits, such as health and happiness, relatives (who, if blest, would probably help the aging kin), companions to cheer, entertainments and diversions, and creature pleasures and comforts That is, these persons seemed largely dependent upon their immediate environments for satisfactions and pleasures The paying group seemed to be characterized by special interests in their future experiences, both worldly and heavenly, and in philanthropic affairs These characteristics of the two groups were probably, with the exception of interests in future special benefits, not altogether new to the individuals in the groups nor peculiar to their time of life Probably in the main, the individuals of each group had long shown much the same interests in life that they did when as elderly people they were asked to express their three main wishes The underprivileged group are usually found to be preoccupied with immediate interests and dependent upon their environment rather than upon resources within themselves for their satisfactions The more fortunate groups, perhaps because immediate needs are more generously provided, have interests beyond the present and concrete, and have developed within themselves resources for realizing their greatest satisfactions.

TABLE 2

CONDENSED COMPARISON OF GROUPS BY PERCENTAGES

Number	Elderly Pay 48	Elderly Char 55	Elderly Total 103	Women students 129	Children 11-12 100	Children 5-6 100
Specific objects, possessions & activities (I, III, IV)	18.9	19.4	19.1	14.6	27	62
Money, wealth (II)	2.8	18.8	11.4	14.8	6	5
Opportunities & Accomplishments, Improvements (V, VII, VIII, IX, X, XI)	2.8	3	2.9	11.5	8	5
Vocation (VI)	0	1.8	1.0	17.2	6	4
Companionship, relatives & friends (XII, XIV, XV)	9.1	12.1	10.7	7.3	15	8
Marriage (XIII)	1.4	3.6	2.6	8.9	2	1
Benefits for self (XVI) XVIII, XIX)	19.1	28.5	24.3	11.2	7	5
Specific Benefits for self (XXII)	28	0.6	13.3	0	0	0
Benefits for relatives (XVII, XX)	7.7	10.3	9.1	5.5	15	3
Philanthropic, etc (XXI)	10.5	1.8	5.8	8.1	13	5
Total	100.3	99.9	100.2	99.1	99	98

Table 2 compares the wishes of these two groups, both separately and combined, with the wishes of a group of 129 college women students, 100 11-12-year old and 100 5-6-year old boys and girls, according to a combination of the classificatory categories The following differences between the student and elderly groups are suggestive

1—*The students had more wishes for*
V, VII, VIII, IX, and X, opportunities, accomplishments, improvements, and prestige — 11.5% students; 2.9% elderly
VI, Vocational interests — 17.2% students; 1.0% elderly
XIII, marriage — 8.9% students; 2.6% elderly

compared with the charity group only, for
XXI, philanthropic — 8.1% students; 1.8% elderly, charity

compared with the paying group only
II, money and wealth — 14.8% students; 2.8% elderly, paying

2—*The elderly had more wishes for*
XVI, XVIII, XIX benefits for self, especially the charity group — 28.5% charity group; 19.1% paying group; 11.2% students

XVII, XX, benefits for relatives, especially the charity group	10 3% charity group 7.0% paying group 5 5% students
possibly	
I, III, IV, possessions and activities	19 1% elderly groups 14.6% students
The charity group only had more wishes for	
XII, XIV, XV, companionships, relatives, friends	12 1% charity group 7.3% students
The paying group only had more wishes for	
XXII, specific benefits for future	28 0% paying group 0 0% students

3—*The paying group of elderly persons was more like the students than was the charity group as to*

XVII, XX, benefits to relatives	7 7% paying group 5 5% students
XXI, philanthropic, etc.	10 5% paying group 8 1% students
XII, XIV, XV, companionships	9 1% paying group 7 3% students

4—*The charity group was more like the students than was the paying group as to*

XXII, specific benefits for the future	0 6% charity group 0 0% students

Comparisons of the elderly groups with the children groups shows

Tendencies to similarity in	
V, VII, VIII, IX, X, opportunities, accomplishments, improvements and prestige	2 9% elderly groups 8 0% 11-12 yr old 5 0% 5 6 yr. old
VI, vocational affairs	1 0% elderly 6 0% 11-12 yr old 4 0% 5-6 yr old
XIII, marriage	2 6% elderly 2 0% 11-12 yr old 1 0% 5-6 yr. old
In the case of the paying group only, as to.	
II, money and wealth	2 8% paying group 6 0% 11-12 yr old 5 0% 5-6 yr old
In the case of the paying and 11-12 yr old groups, as to	
XXI, philanthropic interests	10 5% paying group 13.0% 11-12 yr old

In the one respect of wishes for companionship all groups showed about the same considerable interests, the percentages running 9 1, 12.1, 10 7, 7.3, 15 and 8 for the six groupings, respectively

In summary, the most striking comparisons seem to be that the elderly stood *between the students and the children in regard to wishes for*

I, III, IV, possessions and activities	14 6% students 19 1% elderly 27 % 11-12 yr old 62 % 5-6 yr old

They stood at the lowest end of the four groups as to	
V, VII, VIII, opportunities, accomplishments, improvements and prestige	11 5% students
	8 % 11-12 yr old
	5 % 5 6 yr old
	2 9% elderly
VI, vocations	17 2% students
	6 % 11-12 yr old
	4 % 5-6 yr old
	1 0% elderly
They stood at the highest end of the four groups as to	
XVI, XVIII, XIX, benefits for self	24 3% elderly
	11.2% students
	7 % 11-12 yr old
	5 % 5-6 yr old

These similarities and differences may have been dependent, in part, on socio-economic and cultural experiences as well as upon age The marked differences between the wishes of the two elderly groups as to the future and as to philanthropic interests suggest such a probability

In the report on wishes of college women an attempt was made to indicate the probability or impossibility of attainment of the wishes made A similar attempt has been made as to the wishes of the elderly In Table 1 the three letters *p*, *u* and *i*, placed before each wish expression, have been used to indicate whether the wishes were, in all reason, possible, unlikely, or impossible of attainment. The percentages of each are shown and compared with the students' wishes in Table 3

TABLE 3

	Elderly Groups			
	Paying	Charity	Total	Students
Impossible	16	3 5	9 7	3 9
Unlikely (probably unattainable)	44	34 7	38 6	9 2
Possible (probably attainable)	40	61 8	51 6	86 9

The figures show quite striking contrasts Nearly 87 per cent of the students' wishes seemed (to the writer) "probably attainable", but only about 50 per cent of the elderly people's wishes seemed even possible of attainment The difference between the paying and charity groups in this regard was also striking, being 40 per cent and 61 8 per cent respectively Furthermore, inspection of Table 1 will show that many wishes were marked *p* which in all likelihood

will never be realized, such as having a victrola or radio, or which are matters of religious faith, for example, *see dear ones in Heaven*, (which this writer dare not say unlikely or impossible), or which may eventuate, but not through any efforts on the part of the wishers, such as *welfare of children, health for sister, easy death*, and the like. In fact, looked at as possible of attainment through the individual efforts of these elderly persons very, very few of the wishes seem probable, even possible of attainment. On the other hand, as was pointed out in the report on the wishes of the students, the 86.9 per cent of the wishes seemed "reasonably attainable with some effort and constancy put forth on the part of the ones interested." In this very respect, perhaps, the differences between elderly and young are most striking. Both would have certain objectives. To the young these are possible because they have within themselves the possibilities for making the wishes come true. To the elderly the same, or almost all other wishes are tragically impossible because they have within themselves no powers by which to bring the wishes into fulfilment.

In his study of children's wishes Jersild observed: "As revealed by their wishes, children's thoughts are directed more toward accomplished objective facts than toward the possession of powers within themselves, which would enable them to win the things they desire" (2, p. 259). "Perusal of the students' wishes . . . indicates that they too largely disregard inner powers as the means by which to win the things they desired" (3, p. 95). So did these elderly people. Perhaps the suggestion of Jersild is true for people generally, young and old. Perhaps it is aimed at teachers, parents, and leaders who are concerned with influencing the strong motives for human behavior. Is it practicable, or desirable, to educate people generally to wish for skills, abilities, likes, desires, etc., the employment of which would do something or much to bring about conditions of individual and social welfare?

The more practical nature of the wishes of the charity group in contrast to the paying group is interesting to note. Not only is the percentage of possible wishes half as much greater, but the particular objectives seem much more practical in the sense of possible realization. For example, *clothes, food* and *cigars*, are much more likely obtainable than *a small boat, summer or country home, cottage near the seashore*, etc., *entertainment* is more practically possible than to

live in England, companionship, than *benefits for relatives; health and happiness,* than *easy death* and spiritual joys after death A philosophical essay on how to wish might be undertaken here by some daring student in ethics!

B Wishes of College Men

Fifty male students at Cornell University contributed the data for the second part of the report.[2] Forty-five of the students were undergraduates, and five were in the graduate school Ages ranged from 17 to 25, and the fields of specialization were very varied and evidently quite representative of the interests of college students generally. The respondees were asked to answer anonymously the

TABLE 4

PERCENTAGES OF FIRST THREE WISHES OF 129 WOMEN AND 50 MEN COLLEGE STUDENTS ACCORDING TO JERSILD'S CLASSIFICATIONS

	Classifications	Number	Women 129	Men 50
I	Specific objects		1 6	0
II	Money		14 8	20 0
III	Good living quarters		1 8	0
IV	Activity, sports, diversions		11 2	0 7
V.	Opportunities and accomplishments		5 2	0 7
VI	Vocation		17 2	26 7
VII	Be bright and smart		2 9	1 4
VIII	Moral self-improvement		1 8	0 7
IX	Improved personal appearance		0	0
X	Prestige, adventure		1 6	6 0
XI	Supernatural power		0	0
XII.	Baby, sibling		2 3	0
XIII	Marriage		8 9	22 7
XIV	Parents never die		0 3	0
XV	Companionship		4 7	2 7
XVI	Relief from irritation		0	0
XVII	Specific benefits to parents and relatives		0 8	0 7
XVIII	General benefits for self		10 9	14 6
XIX	General immunities for self		0 3	0
XX	General benefits for relatives		4 7	0
XXI	General benefits for others, philanthropies, etc		8 1	3 4
	Totals		99 1	100 3

[2]These data were secured through the courtesy and cooperation of Professor Henry P. Weld, Department of Psychology, Cornell University, to whom thanks are expressed

following question "What would be your three most important wishes, listing them according to their importance, that you would make if you thought that at some time these wishes would materialize?"

Table 4 gives the main features of the data in comparison with the 129 college women of the earlier study and according to Jersild's 21 main categories The table indicates that the men differed materially from the women in the following interests

1—*More interest in*		
VI, vocations	26.7% men	17.2% women
XIII, marriage	22.7% men	8.9% women
possibly in		
X, prestige	6.0% men,	1.6% women
II, money and wealth	20.0% men	14.8% women
2—*Less interest in*		
IV, activities, etc	0.7% men,	11.2% women
V, opportunities and accomplishments	0.7% men	5.2% women
XX, general benefits for relatives	0.0% men	4.7% women
XXI, philanthropies, etc	3.4% men	8.1% women
3—*They showed about the same interest in*		
XV, companionship	2.7% men	4.7% women
XVIII, general benefits for self	14.6% men	10.9% women

They also showed about the same interest in the several categories in which both groups indicated little if any interest, namely specific objects, good living quarters, to be bright, moral self-improvement, improved personal appearance, superstitions, having baby, parents never die, relief from irritations, specific benefits to parents and relatives, general immunities for self

It would seem from these data, therefore, that college men were much more interested than college women in marriage and vocational matters and that this greater interest was chiefly at the expense of interests in altruistic affairs and in possessions other than money

Comparisons of the elderly groups and the college men may be made by reference to Tables 2 and 4. The following differences seem striking, as the college men were:

1—*More interested in*·	
VI, vocations	26.7% college
	0.0% paying group
	1.8% charity group
XIII, marriage	22.7% college
	1.4% paying group
	3.6% charity group

X, prestige, adventure	6.0% college
	0.0% paying group
	3.0% charity group
compared with paying group only in	
II, money and wealth	20.0% college
	2.8% paying group
2—*Less interested in*	
I, specific objects	0.0% college
	9.1% paying group
	6.7% charity group
IV, activities, etc	0.7% college
	9.1% paying group
	10.9% charity group
compared with the charity group only	
XV, companionship	2.7% college
	12.1% charity group
XVII, specific benefits to parents and relatives	0.7% college
	9.1% charity group
XVIII, general benefits for self	14.6% college
	28.5% charity group
compared with the paying group only	
XXII, specific benefits for self	0.0% college
	28.0% paying group
XXI, general benefits for others, philanthropies, etc.	3.4% college
	10.5% paying group

The college men were like the elderly groups in showing little or no interests in good living quarters, opportunities and accomplishments, being bright, moral self-improvement, improved personal appearance, having baby, parents or relatives never die, relief from irritation, general immunities for self and general benefits for relatives

They were similar to the charity group, only, in wishes regarding XXI, general benefits to others	
	3.4% college men
	1.8% charity group
They were similar to the paying group, only, in wishes regarding	
XV, companionship	2.7% college men
	3.5% paying group
XVII, specific benefits to parents and relatives	0.7% college men
	3.5% paying group
XVIII, general benefits for self	14.6% college men
	17.7% paying group

Table 5 is a comparative table in condensed form of all the groups discussed—college men, college women, elderly, and children. It is an interesting table because it shows in six of the seven special categories of the table definite tendencies from the children groups through elderly groups, women and men, in that order. The trends

TABLE 5

COMPARISONS OF FIVE GROUPS BY CERTAIN SEPARATE AND BY COMBINED CATEGORIES OF WISHES

	College men	College women	Elderly (combined)	Children 11-12	Children 5-6
1—Possessions & activities (I, III, IV)	0.7	14.6	19.1	27	62
2—Money (II)	20	14.8	11.4	6	5
3—Vocations (VI)	26.7	17.2	1.0	6	0
4—Phys'l and Psych'l Benefits for self (V, VII, VIII, IX, X, XI, XVI, XVIII, XIX, XXII)	23.4	22.7	40.5	15	14
5—Social Relationships (XII, XIV, XV)	2.7	7.3	10.7	15	8
6—Marriage (XIII)	22.7	8.9	2.6	2	1
7—Altruistic (XVII, XX, XXI)	4.1	13.6	14.0	28	8
Totals	100.3	99.1	100.2	99	98

are (*a*) Decreasing interest from children to college men in No 1, possessions and activities; No 5, social relationships; and No 7, altruistic affairs, (*b*) increasing interests in No 2, money and wealth; No 3, vocations, and No. 6, marriage In the combined Category 4 the college men and women were similar The speculative query may be raised as to the relative superiority of the wishes of the college men on the basis of these apparent trends A factor may be involved which is also somewhat speculative namely, the possibly higher selection of the Cornell college students in comparison with the other groups

C. BIRTHDAY WISHES OF GRADE 1 CHILDREN

In a study of birthday wishes of Grade 1 children at present underway there are data making possible comparisons with the wishes of the other groups discussed in Sections *A* and *B* The wishes of these children were made during birthday celebrations held at the mid-morning lunch hours whenever a child present had a birthday. The pupils were attending the Horace Mann School of Teachers College, and were having the sort of school life broadly described as *informal living together*, under the guidance of a superior teacher The interests of the children were the centers of their school experiences, so that the birthday occasions were natural opportunities for

making birthday wishes. The words of the children were taken down verbatim by a stenographer observing in the room for that and other purposes. It is felt certain that the presence of the stenographer had no appreciable effect—inhibitory or otherwise—on the children, who were accustomed to constant visitors and observers. The home backgrounds, the mental abilities, and the school opportunities of this group were much above average. As evidence, a large majority of the parents of the pupils were professional persons, and most of them were college graduates.

There were recorded altogether 207 wish statements made by these children during the year. These statements were analyzed as to particular wishes and these in turn were classified according to Jersild's categories. There were 285 such separate wishes. Table 6 shows the percentages of the birthday wishes, using both the 207 first wishes and the total 285 wishes for bases, compared with those of the women students and the 11-12 and 5-6 year old children groups. The table is arranged in the order of the size of the students' wishes.

Comparison of the birthday wishes and the wishes of the other children groups shows the following:

1—*The children making birthday wishes showed greater interest than those in both of the other childen groups in*

VI, vocations	9.5%	(285)
	12.6%	(207)
	6 %	11-12 yr. old
	0 %	5-6 yr. old
IV, activities, etc.	18.6%	(285)
	22.2%	(207)
	8 %	11-12 yr. old
	6 %	5-6 yr. old
XVIII, general benefits for self	17.5%	(285)
	19.8%	(207)
	6 %	11-12 yr. old
	3 %	5-6 yr. old
XIII, marriage	6.3%	(285)
	5.8%	(207)
	2 %	11-12 yr. old
	1 %	5-6 yr. old
X, prestige, adventure	7.4%	(285)
	8.2%	(207)
	0 %	11-12 yr. old
	1 %	5-6 yr. old

2—*They showed less interest in*

XXI, general benefits for others	0 %	(285 and 207)
	13 %	11-12 yr. old
	5 %	5-6 yr. old

TABLE 6

PERCENTAGES OF WISHES OF STUDENTS, 11-12 YEAR OLD CHILDREN, 5 6 YEAR OLD CHILDREN, AND BIRTHDAY WISHES*

		Students	Children 11-12	Children 5-6	Birthday wishes All wishes	Birthday wishes 1st wishes
	Number of wishes	387	100	100	285	207
VI	Vocation	17.2	6	0	9.5	12.6
II	Money	14.8	6	5	16.8	5.3
IV	Activities, sports, diversions	11.2	8	6	18.6	22.2
XVIII.	General inclusive benefits for self	10.9	6	3	17.5	19.8
XIII	To be married, have a lover	8.9	2	1	6.3	5.8
XXI.	General benefits for others, philanthropies etc.	8.1	13	5	0	0
V	Opportunities and accomplishments	5.2	7	4	3.5	4.8
XV.	Companionship, etc.	4.7	4	1	0	0
XX	General benefits for relatives	4.7	8	0	0	0
VII	Be bright, smart	2.9	1	0	0.4	0
XII	Have baby, sibling	2.3	4	6	1.4	1.0
VIII	Moral self-improvement	1.8	0	0	0.4	0.5
III	Good living quarters	1.8	5	1	3.9	2.9
I	Specific material objects and possessions	1.6	14	55	14.0	16.4
X	Personal prestige, adventure	1.6	0	1	7.4	8.2
XVII	Specific benefits for parents and relatives	8	7	3	0	0
XIV.	Parents never die	3	7	1	0	0
XIX	General immunities for self	3	0	0	0	0
IX	Improved personal appearance	0.0	0	0	0.4	0.5
XI	Supernatural power	0.0	0	4	0	0
XVI.	Relief from irritations, etc	0.0	1	2	0	0
	No responses or unintelligible	0.0	1	2	0	0
	Totals	99.1	100	100	100.1	100.0

*The percentages shown for student and children groups were computed on slightly different bases For the adults the three wishes given by each student were totaled and that used as the base to get the percentages. *For the children the first wish only of each child was used*

possibly XII, have baby, sibling	1.4% (285)
	1.0% (207)
	4 % 11-12 yr old
	6 % 5-6 yr old
XVII, specific benefits for parents and relatives	0% (285 and 207)
	7% 11-12 yr old
	3% 5-6 yr old

They showed less interest than the 11-12 year old group, only, in

XX, general benefits for relatives	0% (285 and 207)
	8% 11-12 yr old
	0% 5-6 yr old

They showed less interest than the 5-6 year old group, only, in

I, specific objects and possessions	14.0% (285)
	16.4% (207)
	55 % 5-6 yr old
	14 % 11-12 yr old

The percentages of birthday wishes approached those of the students in:

VI, vocation	6.0% 11-12 yr old
	9.5% (285)
	12.6% (207)
	17.2% students
II, money*	6.0% 11-12 yr old
	16.8% (285)
	5.3% (207)
	14.8% students
XIII, marriage	2.0% 11-12 yrs old
	6.3% (285)
	5.8% (207)
	8.9% students
V, opportunities and accomplishments	7.0% 11-12 yr old
	3.5% (285)
	4.8% (207)
	5.2% students

They exceeded the students in:

IV, activities, etc	18.6% (285)
	22.2% (207)
	11.2% students
XVIII, general benefits for self	17.5% (285)
	19.8% (207)
	10.9% students
X, prestige, adventure	7.4% (285)
	8.2% (207)
	1.6% students

They showed a smaller percentage than the students in

XXI, philanthropic, etc	0.0% (285 and 207)
	8.1% students

*The considerable difference between the percentages of total and first birthday wishes for money and wealth seems to have been due to the frequent stereotype wish that the recipient be "healthy and wealthy." This expression placed "wealthy" as a second wish, hence the much greater percentage for money and wealth when all 285 wishes were considered.

Explanations for these differences are probably numerous and involved, but a few seem worth suggesting The fewer birthday wishes for benefits to relatives and others (XVII, XX, and XXI) seem logical when it is remembered that the American custom makes birthdays occasions for focusing attention on the celebrant, who becomes the Great Receiving One Young children would not likely think of wishing benefits for others as a means for bringing benefits to a third Other explanations would be related to the more favored nature and environment of the children who made the birthday wishes, compared with the other children groups, which were composed of children much more average in these respects The greater privileges of their circumstances had probably much the same effect upon these young children making birthday wishes as the similar conditions pointed out in Section *A* had to do with the wishes of the paying elderly group studied therein.

D. Summary and Conclusions

Collections of the expressed wishes of two elderly groups of people and one group of college men, and the birthday wishes of children in a first grade, were analyzed according to Jersild's classification of children's wishes, and compared with wishes of college women, 11-12 year old and 5-6 year old children previously reported The samplings of the populations of elderly persons and college men were inadequate for drawing final conclusions, but indicated the possibility of finding, in much larger samplings, differences that might be suggestive and perhaps helpful in understanding and controlling the wishes of people The following points were indicated by the limited data

1. Culture and socio-economic background, as well as chronological age, affect people's wishes, probably both in very early and in late life.

2 The wishes of the elderly groups seemed roughly to place these groups between the children and the college students in most respects

3 The wishes of elderly groups seemed much more improbable of attainment than those of college women students This seemed more generally true of the economically more privileged than of the underprivileged group

4. The expressed wishes of a group of college men, possibly more highly selected than the other adult groups, seemed more mature in most respects than the wishes of any of the other groups.

5. A very highly selected group of children made birthday wishes which, when classified according to Jersild's categories, were more like adults' wishes than like those of the other children groups studied.

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The Journal of Genetic Psychology, 1939, 55, 103-120

THE COMPARISON OF TEMPORAL INTERVALS IN JUDGING DEPTH OF SLEEP IN NEWBORN INFANTS*

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A INTRODUCTION

In order to interpret the reactions of newborn infants to various stimuli, we must have some knowledge of the condition of the infant at the time of stimulation In the past, investigators have described such a condition rather vaguely, generally employing terms such as "awake" or "asleep," though the meaning of these terms seemed to vary from one experimenter to another

An effort was made by Wagner (17) to establish a criterion for various degrees of depth of sleep in order to facilitate accurate descriptions of an infant's condition at the time of stimulation A series of stages of depth of sleep, described as patterns of overt motility and breathing, was determined in terms of the duration and extent of response to a variety of stimuli The study was based on the assumption that the shorter and less extensive the response, the deeper is the infant's sleep.

Her initial classification of motility conditions in the infant was as follows

A *Generally quiet*
  1 No eyelid or mouth movement
    a Regular breathing
    b Irregular breathing
  2. Eyelid movement
  3 Eyelid and mouth movement
  4 Eyes open
  5. Eyes open and mouth movement
B *Occasional stirs of body members*
  1 No eyelid or mouth movement
  2 Eyelid movement
  3 Eyelid and mouth movement
  4 Eyes open
  5 Eyes open and mouth movement

*Received in the Editorial Office on August 29, 1938

[1]We are indebted to Dr Andrews Rogers for his cooperation, and to Dr Isabelle F Wagner for her valuable assistance in standardizing the procedure and analyzing the data

C. *Generally active.*
   1 No eyelid or mouth movement
   2 Eyelid movement
   3 Eyelid and mouth movement
   4 Eyes open.
   5 Eyes open and mouth movement

Her results indicated that the stages of depth of sleep were, from deepest to lightest sleep.

$$A_{1_a}$$
$$A_{1_b}$$
$$B_1$$
$$A_2,\ A_3,\ B_2$$
$$B_3$$
$$C_2,\ C_3$$
$$B_4\text{–}B_5\text{–}C_5$$

The classifications omitted were those which were not significantly different, statistically, from the other conditions

With the criteria of depth of sleep determined, the next problem is the determination of the length of time a condition should be observed in order to be certain that a judgment of depth of sleep is accurate This seemingly obvious question has seldom been given more than the most superficial thought, and investigators have arbitrarily set their own time intervals in which they believe they can judge the condition of their subjects. These intervals have ranged from 10 seconds to 15 minutes, and often there is no definite interval given, the time being "the period it takes for the infant to become quiet." In only one or two instances is a reason given for using a particular interval, and none of these appear to be supported by adequate and significant evidence

In 1929, Weiss (18), in writing on the measurement of infant behavior, said of the duration of the control period (the purpose of which, presumably, is to get a characteristic picture of behavior with no stimulations), "Three forms of distribution are used. (*a*) 10 minutes at the beginning, (*b*) 10 minutes in the middle, and (*c*) five minutes at the beginning and five minutes at the end." These forms were alternated for different days, and were thus distributed by chance Pratt, Nelson, and Sun (13) used the above intervals for their control periods.

Irwin in 1930 (7) of course used no control periods in his continuous record study, but in tabulating his data, he used 10 minutes

as the primary unit of time and tabulated the frequency of each movement during the 10-minute period These data were then transferred to an hour-total sheet, three-hour observation period, and finally a complete day In a succeeding study (6) where 3½ hours of recording were done at a time, his data were tabulated for each 15-minute period, and in part of the records the data were tabulated for each 5-minute period as well Irwin states that the curves of judgments made during 5-minute and during 15-intervals "approximate each other."

In 1932 Jensen (8) observed his infants at least 15 minutes before and at least 15 minutes after each stimulation period. Marquis in 1933 (9) used the one-minute interval in which to judge whether her subjects were asleep or awake In the study of children's sleep made by Renshaw, Miller, and Marquis in 1933 (14), no stimuli were used, but one minute was used as the unit of time in tabulating the records of the movements made by the children during sleep If movement or activity occurred in any portion of a minute, that was counted as an active minute.

Smith (15) recorded at one-minute intervals, throughout her experiment on the brightness value of three hues, whether the infant was silent or crying and whether his eyes were open or shut Wenger in 1934 (19) used a 5-minute interval to judge increases and decreases in skin resistance during sleeping and waking

In Pratt's 1934 studies on visual and auditory stimulations (11, 12), he used a 2-minute adaptation period after the infant had been placed on the experimental table, a 10-minute control period in which activity was recorded, but no stimuli given, and a 10-minute experimental period in which stimuli were given at determined intervals The order of these periods was changed from day to day. Disher (2) used a 5-minute period between stimuli, and, since stimuli were presented only when the infant was quiet, this period was sometimes longer

Dockeray and Rice (3) used a one-minute interval and the conditions "quiet and eyes usually closed" in order to judge a condition of sleep in their subjects. Delman (1) used the shortest period of observation given, although other investigators may have used a similar interval and failed to mention it in their studies He allowed an interval of "at least" ten seconds' immobility before any stimulus was applied.

In Wagner's study cited earlier, a one-minute interval preceding stimulation was used to judge the condition of the infant She was the only investigator to state a reason for using a particular time interval She says.

> The choice of a one-minute interval was not a casual decision. Continuous records in a preliminary investigation were obtained for the periods between feedings, behavior annotations were made on the polygraph tape, but no stimuli were applied These records were scanned carefully in order . to choose an interval most sensitive to the type of behavior trends noted An interval of two minutes or longer would have obscured a brief change in trend, but an interval as short as thirty seconds, for example, would have emphasized these slight variations far too much, it seemed to the experimenter. A minute appeared to be about the length of time necessary to determine the particular behavior pattern existing before the presentation of the stimulus

She gives no evidence to support or justify her conclusions, but this will be given later.

B. Purpose

The question now arises as to whether it is possible to discover through experimental evidence a time interval which will enable the observer to judge fairly accurately the depth of sleep of the infant. This study undertakes to answer this question by studying variations in behavior during the various stages of sleep listed by Wagner (17). So little consideration has been given directly to this problem that this investigation may not answer the question adequately, but it is hoped that it will aid investigators in the future with their research on the newborn infant

C Apparatus and Method

Each infant studied was placed in the experimental cabinet described in detail by Pratt, Nelson, and Sun (13). Records of general motility were secured by means of the stabilimeter used by those investigators In place of the toy-balloon pneumograph was substituted a specially constructed pneumograph suitable for work with small infants. This consisted of a relatively soft rubber tube, ten millimeters in diameter, with wall approximately one millimeter

thick. The ends were closed by rubber stoppers with a smaller tube leading to a Marey tambour connected to one end. A strip of thin flexible steel the width and length of the pneumograph tube and slightly curved to approximately the form of the infant's trunk was placed over this tube and attached at each end. The whole pneumograph was then attached to a bandage strip slightly larger than the girth of the infant. The device was placed with the tube next to the infant and the steel band on top, and was fastened securely around the infant just below the ribs with adhesive tape. As the infant breathed, the tube was compressed against the steel band and a maximal amount of air pressure was thus transmitted through the small rubber tube to the Marey tambour recorder, which made an ink tracing on the polygraph tape.

The general conditions of the experiment were in most respects the same as those described by Wagner. The records, variable in length, were secured between the one-o'clock and four-o'clock feedings; they started between 2:15 and 2:30 and ended between 3:00 and 3:30, depending on the condition of the infant. The subjects used were normal, full-term infants from the charity ward of the hospital and varied in age from 12 hours to 10 days. A total of 54 records was obtained with 19 infants, one to ten records being taken on each infant. There were ten girls and nine boys, all white except one colored girl. The total number of records taken at each age level, from one to ten days inclusive, was: 7, 7, 7, 7, 6, 4, 5, 4, 5, 2. One of the experimenters observed face, eyelid, and mouth movements from the side of the cabinet while the other observed limb and trunk movements through the aperture at the end of the cabinet. The latter observations were written directly upon the polygraph tape, the former recorded parallel on a time record and later transferred to the tape. The symbols used in recording were those employed by Wagner. The records were later marked off into minutes when the speed of the moving tape had been calibrated (one minute = 23.5 cm.).

When the records had been divided into minutes, each minute was classified according to the previously stated classifications used by Wagner. The reader is referred to her article for a careful description of these conditions. Since she noted few conditions of mouth movement unaccompanied by eyelid movement, she made no provision for this in her classification. In the present experiment, where such cases were observed they were recorded as A_{1_m}, B_{1_m}, and C_{1_m}.

Roman numerals were now assigned to indicate each stage from *I*, indicating deepest sleep, to *VI*, indicating complete waking. These stages, slightly modified, with their equivalents in Wagner's summary, are as follows:

Our Classification	*Wagner's Classification*	
I	A_{1_a}	called "deep sleep"
II	A_{1_b}	
III	B_1	
IV	A_2, A_3, B_2, B_3	called "intermediate
V	C_1, C_2, C_3	stages of sleep"
VI	B_4, B_5, C_4, C_5	called "complete waking"

It will be seen that a few slight modifications were made. Condition B_3 was combined with A_2, A_3, and B_2 for convenience of analysis. Condition C_1, of which the experimenter found numerous instances, was added to C_2 and C_3 in Stage *V*. Conditions B_1, B_5, C_4, and C_5 all include "eyes open," and since an infant with open eyes is universally regarded as "awake," these conditions were all included in the last class.

Two methods were used for presenting the data.

Method of measuring constancy of behavior from minute to minute. A table was constructed with the six stages of sleep depth in order along both the ordinate and the abscissa. The data were then read through minute by minute and the number of times a certain stage was followed by another (or the same) stage was computed. These were given percentage values, since the number of cases would not be the same for all conditions. Percentages in which each condition was followed by all other conditions (and the same condition) were thus computed (*a*) for all infants, (*b*) for the three consecutive ten-day records, (*c*) for each sex, and (*d*) at each age level.

Method of determining variations within each five-minute period. Here the data were divided into five-minute intervals, each interval containing five one-minute periods. Then the condition that existed in the majority number of minutes in each five-minute interval was recorded. Assume that there were three Stage *III*, one Stage *II*, and one Stage *I* in a five-minute interval. This would be recorded as 3—Stage *III*. If there had been four or five Stage *III* conditions in the five-minute interval it would have been recorded as such. Where no condition was present for three minutes or more

within a five-minute interval, it was recorded as a variable interval The number of times each condition was contained five times, four times, and three times, in a five-minute interval, was thus computed, and these results converted into percentages to clarify the figures The number of variable intervals was also recorded. This was done for all infants, and for boys and girls separately There were not enough five-minute intervals at each age level to warrant a comparison for different ages.

D Data and Discussion

1 *Constancy of Behavior from Minute to Minute*

The total results for all infants are given in Table 1 The number of cases for each condition is given in one column and its percentage value is given in the next column to the right The table is read Stage *I* was followed by Stage *I* (itself) 180 times or 74 7 per cent of the time that it occurred. Stage *I* was followed by Stage *II* 23 times or 9 5 per cent of the time that Stage *I* occurred, etc The percentages were computed on the basis of the total times that each condition occurred, added horizontally

Table 1 shows that the largest percentage of constancy in each sleep condition is the one where that stage is followed in the next succeeding minute by an identical condition However, in Stages *II* to *V* inclusive the difference between the largest percentage figure (in which each stage is followed by itself), and the next largest percentage figure is not nearly so great as in Stages *I* and *VI* The highest percentages are 93 for Stage *VI* and 74 for Stage *I* The percentage of time that a sleep condition is followed by itself is greatly decreased in the intermediate stages between deep sleep and complete waking.

An inspection of the data reveals that the *next highest* percentage in each condition tends to approach closer to the *highest* percentage in the intermediate sleep stages, while for Stage *I* and Stage *VI* these differences are very large We can say that for deep sleep the chances are about three out of four, and for complete waking the chances are more than nine out of ten, that these conditions will be followed by identical conditions in the next succeeding minute. For the intermediate stages the chances are much lower, about four out of ten, or less than half, that an intermediate stage of sleep will be identical in the next succeeding minute

TABLE 1

CONSTANCY OF BEHAVIOR FROM MINUTE TO MINUTE

(Total for All Infants)

	I		*II*		*III*		*IV*		*V*		*VI*		
Sleep depth	No cases	Per cent	No cases	Per cent	No cases	Per cent	No cases	Per cent	No cases	Per cent	No cases	Per cent	Total
I	180	74.7	23	9.5	32	13.3	0	0	6	2.5	0	0	241
II	35	9.2	176	45.9	97	25.3	15	3.9	57	14.9	3	.8	383
III	23	5.0	116	25.4	206	45.1	20	4.4	87	19.1	4	1.0	456
IV	0	0	8	8.9	22	24.4	30	33.3	24	26.7	6	6.7	90
V	7	2.4	50	16.9	86	29.1	22	7.5	124	42.1	6	2.0	295
VI	0	0	3	.8	12	3.1	5	1.4	6	1.5	359	93.2	385

The data also show that *aside* from being followed by an identical condition in the next minute.

(*a*) Stage *I* is most likely to be followed by Stage *III*, next likely by Stage *II*,
(*b*) Stage *II* is most likely to be followed by Stage *III*, next likely by Stage *V*,
(*c*) Stage *III* is most likely to be followed by Stage *II*, next likely by Stage *V*,
(*d*) Stage *IV* is most likely to be followed by Stage *V*, next likely by Stage *III*,
(*e*) Stage *V* is most likely to be followed by Stage *III*, next likely by Stage *II*,
(*f*) Stage *VI* is most likely to be followed by Stage *III*, next likely by Stage *V*, but these percentages are so small as to have no significance in this comparison

We can therefore say that any of the intermediate stages can be followed by any other intermediate stage of sleep, although the chances for this are not quite so great as the chances of their being followed by themselves However, we can safely say that behavior in the intermediate stages of sleep tends to be variable from one minute to the next, while behavior in deep sleep and complete waking tends to be followed by the same behavior in the next minute

Tabulation of the data with respect to sex showed no significant differences between the percentages for boys and those for girls in the constancy of behavior from minute to minute. The greatest differences are for Stage *IV*, and the small number of cases at this stage (31 for boys, 59 for girls) would probably account at least in part for these differences

A comparison of the percentages for the total 10 days of each of the three infants who had consecutive 10-day records was also made The total cases for the three infants were 244, 300 and 239 respectively. Great variation in behavior was found from one infant to another For example, Stage *I* was followed by itself in 80 per cent of the cases for Infant No 1, 87 per cent for Infant No 2, but not at all for Infant No. 3, Stage *I* was followed by Stage *II* in 10 per cent, 5 5 per cent and 100 per cent for the three infants respectively Thus, while one may predict the constancy or variability of behavior from an average of a number of infants, there are still wide variations among individual infants Further-

more, with these three infants as with the group of infants as a whole, the extreme stages of sleep and waking are more constant than are the intermediate stages In other words, almost any infant will be likely to have identical behavior from minute to minute in deep sleep or complete waking, but the intermediate stages show large variations, although the same general trend prevails from one infant to another.

All records were assembled for each age level, but the number of cases for each day (ranging from four to seven records per day with 102 to 286 cases each) was considered too small to justify a comparison of the entire percentages. However, the percentage of times that each condition is followed by *itself* in the next succeeding minute was computed for each day from one to eight days inclusive. These results are given in Table 2.

TABLE 2
COMPARISON OF AGE LEVELS FOR PERCENTAGE OF TIMES IN WHICH EACH SLEEP STAGE IS FOLLOWED BY *itself*—(1-8 DAYS)

Age	*I* followed by itself	*II* followed by itself	*III* followed by itself	*IV* followed by itself	*V* followed by itself	*VI* followed by itself
	%	%	%	%	%	%
1 day	79.1	55 9	55 4	27 3	53 1	92 2
2 days	79.1	37 8	35.7	**	56 8	90 9
3 days	45 5	20 0	63 6	60 0	60 5	92 7
4 days	75.0	40.2	44 9	28 6	28 1	95 6
5 days	33 3	39 6	26 0	**	53 5	97 4
6 days	54 6	61.9	36 4	**	52 0	66 0
7 days	**	71.4	52 4	20 0	23 1	91 1
8 days	91 2	36 0	29.6	**	7 7	94 4

**Too few cases, percentages not significant.

Percentages for Stage *VI* are very constant from day to day With the exception of the sixth day, when there were only three cases, the percentage of times that Stage *VI* is followed by itself ranges from 90 9 per cent to 97.4 per cent The daily variations for all other stages are more marked Stage *I* ranges from 33 3 per cent to 91.2 per cent, Stage *II* from 20 per cent to 71 4 per cent, Stage *III* from 26 per cent to 63 per cent, Stage *IV* from 20 per cent to 60 per cent, and Stage *V* from 23 per cent to 60.5 per cent No definite trends can be noted from day to day for the different conditions Table 2 supports our previous findings by showing that from

day to day Stage *VI*, complete waking, is much less variable than the intermediate stages of sleep. It does not bear out the same conclusion for Stage *I*, deep sleep, however, although the percentages for this stage are still in general larger than for the intermediate stages.

2 *Variations Within Each Five-Minute Period*

Table 3 gives the results for all infants of the number of times and percentages that a five-minute interval contains five, four, and three identical conditions within it

TABLE 3
PERCENTAGE OF FIVE-MINUTE INTERVALS WITH IDENTICAL CONDITIONS PRESENT 5, 4, AND 3 TIMES WITHIN AN INTERVAL

Sleep depth	Five identical classif within 5-min period		Four identical classif within 5-min period		Three identical classif within 5-min perod		Total
	No cases	Percentage	No cases	Percentage	No. cases	Percentage	
I	22	46 8	16	34 1	9	19 0	47
II	8	14 3	16	28 6	32	57 1	56
III	9	12.7	23	32 4	39	54 9	71
IV	0	0	3	30 0	7	70 0	10
V	7	16 7	8	19 0	27	64 3	42
VI	66	82 5	7	8 7	7	8 8	80
Variable intervals where no condition existed in a majority number of minutes							72
Total five-minute intervals							378

Table 3 shows that the highest percentages for Stages *I* and *VI* occurred under the heading "five identical classifications within the five-minute period" This supports the findings of Section *I*, that behavior within a five-minute period is more constant in deep sleep and complete waking. It is to be noted here, however, that the percentage for Stage *VI* is much larger than for Stage *I*, suggesting that behavior is more likely to be constant within a five-minute interval in complete waking than in deep sleep

The greatest percentages for Stages *II*, *III*, *IV*, and *V* occur under the heading "three identical classifications within a five-minute interval" This likewise supports the findings of Section *I* that behavior in intermediate stages of sleep is less predictable and less likely to be the same within a five-minute period Out of 378 five-minute periods, 72 or 19 per cent of the intervals were too variable

to classify, i.e., there was no condition appearing for a majority (three or more) of times in these intervals. We can conclude from this table that within a five-minute period, the least number of variations occurs in Stage *VI*, complete waking, a larger number occur in Stage *I*, deep sleep, while variations for Stages *II*, *III*, *IV* and V are very large.

Again comparison of variations with reference to sex reveals no clear-cut differences. While the boys show greater percentages in some sleep stages than do the girls, no constant variations for either sex are indicated.

3. *Graphic Representation of Typical "Sleep Curves" for Infants with Records of 50 Minutes or More*

Of the nine individual graphs showing the sleeping behavior for each record of 50 minutes or more, two typical examples are shown (Figure 1).

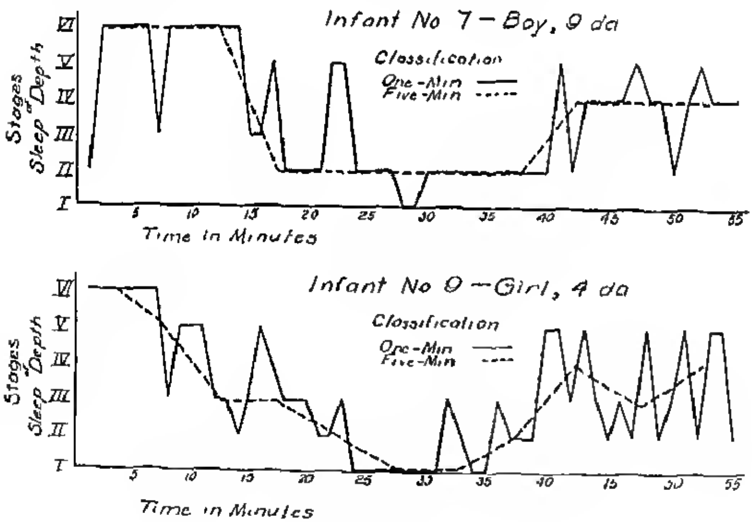

FIGURE 1

Each graph has been constructed on two bases. First, the minute by-minute classification is indicated by a solid line. Then a classification was made for each five-minute interval by arbitrarily giving it

the condition that appeared the majority (three or more) number of times within that interval. These are indicated by a dotted line and show how the sleep curve progresses when based on a five-minute classification. The two curves are readily compared in each record.

A careful inspection of these individual graphs reveal a number of interesting factors. Although there are a number of different types of curves, they are with one exception clearly characterized by a "fall," denoting deep sleep, in the middle of the curves. The length of this "deep-sleep period" varies from 2 to 20 minutes, with an average length of about 10 minutes. There is, therefore, a certain type of sleep curve which is fairly typical of behavior from one-half hour after nursing to one-half hour before the next feeding period. This curve starts in the intermediate or complete waking stage, descends gradually to deep sleep, where it remains for about 5 to 20 minutes, and gradually rises until it is approaching complete waking at the end of the period. Irwin (6), in reporting similar results, says that infants are more likely to be asleep in the middle of the experimental period and more likely to be awake at the beginning and at the end of the period.

The graphs show, further, that behavior does not remain in the same stage for a very long period at a time. The longest periods are in deep sleep and complete waking. Behavior in the intermediate stages of sleep is rarely the same for longer than two or three minutes at a time. An inspection of the curves in Stages *II* to *V* will show rises and falls in behavior at these levels, while straight lines denoting a constancy of behavior are rare for those stages.

Moreover, when the lines are compared, it is seen that a great many rises and falls in sleep depth (indicating rises and cessations of activity) that are shown in the one-minute classifications are lost when the five-minute classifications are used. In other words, a single five-minute classification may cover a wide range of variations that have occurred between the individual minutes of that interval. This is true not so much of deep sleep and complete waking as it is for the intermediate stages of behavior.

E. General Discussion

On the basis of the findings of this investigation, which is the most adequate interval to use in judging depth of sleep, the one-minute interval or the five-minute interval?

1 This percentage is highest for Stages *I* and *VI*, 74 7 per cent for deep sleep and 93 2 per cent for complete waking Deep sleep is followed by the same condition in the next minute nearly three-fourths of the time, while complete waking is followed by the same condition in the next minute over nine-tenths of the time. Intermediate stages are followed by identical conditions less than half of the time.

2. Any one of the intermediate stages of sleep is *almost* as likely to be followed by any other intermediate stage as it is to be followed by itself

3. The variations within a five-minute interval are least for Stage VI (identical one-minute classifications 82.5 per cent of the time), and are slightly larger for Stage *I* (identical one-minute classifications 46 8 per cent of the time), while the intermediate sleep stages are highly variable. Out of 378 five-minute periods, 19 per cent were too variable to be classified.

4 No sex differences were found when determining the constancy of behavior from minute to minute, or within a five-minute interval

5 Wide variations from day to day in the individual records and in the composite table were exhibited from minute to minute. No consistent trends were noted, however The variations were appreciably less for Stages *I* and *VI*

6 Variations from one infant to another were great in both the one-minute and the five-minute classifications. Variations here were also appreciably less for Stages *I* and *VI*.

7 A sleep curve which starts at complete waking, or at one of the intermediate stages, descends gradually to deep sleep, and ascends again to approach complete waking, is a fairly typical sleep curve for infants from one-half hour after nursing to one-half hour before the next feeding period

It is obvious that the question of whether we may judge an infant's condition on the basis of a one-minute or a five-minute observation cannot be conclusively answered from the above data. However, the following recommendations are considered advisable.

First, if an infant is in a deep sleep or complete waking, it will not matter greatly whether a one-minute interval or a five-minute interval is used, according to the Wagner criteria. If, then, an infant is completely awake, the chances are nine out of ten that "awake" is the characteristic condition for that period If an infant is in deep

sleep the chances are three out of four that "asleep" is the characteristic condition at that time Hence, one minute is an adequate interval in which to judge an infant who is deeply asleep or completely awake

The best interval to use in the intermediate sleep conditions, Stages *II* to *V*, is more difficult to determine If a one-minute interval is used, it may not be characteristic of the behavior of the infant at that time for the judgment may fall at one of those single peaks or drops so numerous in the individual graphs. Furthermore, if a five-minute interval is used, and it occurs during intermediate sleep stages, it is likely to be unclassifiable, because a single sleep stage may not appear three or more times within that interval. If it is classifiable on the basis of three identical conditions within the interval, it is likely to obscure trends at the beginning or at the end of the five-minute period which denote that the infant has reached a different stage of sleep at the end of the judgment For example, *III, III, III, II, I* classifications within a five-minute period would indicate that the infant was in deep sleep at the end of the five-minute period, though the period would have to be classified as Stage *III* Other possibilities similar to the above example, such as a rise instead of a drop in behavior at the end of the period, may render the judgment inaccurate for that period

If we examine previous investigations in the light of our data, we shall discover how adequately they judged the condition of their subjects. Pratt, Nelson, and Sun (13) used 10 minutes as a control period before stimulation, in the middle of the experiment, or five minutes before and after the experiment. These were alternated on different days. Their criteria of sleep, "eyes closed most of the time and no skeletal movement," would include Stages *I, II,* and possibly *III* and *IV* if the movements were slight Jensen (8) observed the infant for 15 minutes at the beginning of the experiment and then "noted his physiological condition." He then woke the subject if it was asleep, which suggests that he would probably not have a constant sleep stage for longer than a few minutes until Stage *VI* was reached Marquis (9) used a one-minute interval and regarded the infant as asleep when his eyes had been closed for that period Her criteria included Stages *I, II, III, V,* and possibly *IV,* if eye movements were slight Gilmer (4) recorded the condition of the infant, but there were no criteria of sleep nor mention

of time intervals used. Disher (2) used five minutes for observation and presented the stimulus only if the infant was quiet at least (it is assumed) toward the end of that interval. Her criteria of sleep, "eyes closed and no movement," include Stages *I* and *II*, at least. Dockeray and Rice (3), and Taylor (16) used "quiet for at least one minute, eyes usually closed." This could include Stages *I*, *II*, and possibly *III* and *IV*.

Pratt (11, 12) used a ten-minute control period and a two-minute "adaptation period." In succeeding studies he used a two-minute period "sometimes prolonged until quiescence is attained." His criteria of sleep were presumably the same as in his earlier experiments. Smith (15) recorded the condition of the infant at one-minute intervals, stating whether eyes were open or shut, with respiratory movements recorded by the use of a pneumograph. Wenger (10) attempted to stimulate only when subjects were awake and quiet, "but the condition of the infants often changed during the short interval between the starting of the rotary switch and the actual presentation of the stimuli (about three seconds)." This statement suggests the difficulties of keeping an infant "awake and quiet" long enough to present a series of stimuli.

It can readily be seen that previous investigators have failed to judge in an accurate manner the condition of their subjects at the time of stimulation. This failure has been due to (*a*) lack of adequate sleep criteria, and (*b*) lack of an intelligent use of a time interval for observation. Disher was the only one to approximate the suggested procedure by using a five-minute interval, prolonged if necessary until quiescence was reached. Smith's procedure of recording conditions at one-minute intervals might well be usable if one could do this and at the same time present stimuli and record responses. It is possible that she did not observe behavior throughout each minute, but only recorded it at the end of each minute. This would be a more doubtful procedure.

F. Summary

The sleeping behavior of 19 infants from 12 hours to 10 days old was observed for a total of 54 records 30 to 75 minutes in length. The following conclusions were reached:

1. In determining the constancy of behavior from minute to minute, it was shown that the greatest percentage of cases in all

stages of sleep depth is followed by identical conditions in the next succeeding minute

2 This percentage was highest for complete waking, and next highest for deep sleep Deep sleep is followed by the same condition in the next minute nearly three-fourths of the time, while complete waking is followed by an identical condition in the next minute over nine-tenths of the time. Intermediate stages are followed by identical conditions less than half of the time

3 Any one of the intermediate stages of sleep is *almost* as likely to be followed by any other intermediate stage as it is to be followed by itself

4 Variations within a five-minute interval are least for complete waking, and are slightly larger for deep sleep, while intermediate stages of sleep are highly variable

5. There were no sex differences found in this study.

6 Wide variations were found in the same infant at different age levels, and large differences between individual infants at the same age level were noted These variations were appreciably less in all cases for deep sleep and complete waking

7 The typical sleep curve for infants from one-half hour after nursing to one-half hour before the next feeding period starts at complete waking, or at one of the intermediate stages, descends gradually to deep sleep for five to twenty minutes, and ascends slowly to approach complete waking at the end of the period

An outline of a procedure for obtaining the most accurate judgment of the condition of an infant was recommended

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CURVES OF SLEEP DEPTH IN NEWBORN INFANTS*

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In an earlier investigation (7) the writer established a criterion of depth of sleep in terms of the extent and duration of response to a variety of stimuli Seven stages of sleep depth were determined which were recognizable as discrete patterns of overt motility

Once these stages were described, the investigator could proceed to answer still other questions concerning the sleep of newborn infants, as to the nature of their sleep curves, and the amount of time spent in each stage of sleep. These and other related questions are answered in the following report

A Apparatus and Method

The improved experimental cabinet recently described by Dr. F. C. Dockeray (2) was used in this study Though this cabinet is soundproof and air-conditioned, in this study the front doors were swung open and a heavy, protective curtain extended from the upper edge of the cabinet out over the farther edges of the doors in such a way as to provide a small recess for polygraph and experimenter; this arrangement allowed closer observation of the infant than was possible through the apertures in the doors Temperatures were kept between 86° and 88°, illumination was afforded by a blue 50-watt Lumoline bulb Beside the cabinet was placed a stand bearing a polygraph; on the tape were recorded a breathing curve and running annotations, in appropriate symbols, of observed behavior The pneumograph described by Reynard and Dockeray (5) was used

The infant was brought in at about two o'clock in the afternoon and placed inside the cabinet, parallel to the open side, with the head turned toward the experimenter The pneumograph was strapped over the infant's abdomen just below the lowest ribs, and the polygraph started All records were secured in the period between the

*Recommended for publication by F. C Dockeray, and received in the Editorial Office on August 29, 1938

one-o'clock and four-o'clock feedings; the hospital routine was such that the infants were available only from about two o'clock to three-thirty, during which interval a continuous record was obtained. A few records were longer and a few shorter, but as a whole they averaged 90 minutes in length

The speed of the apparatus was calibrated so that each record could be marked off into minutes These minute intervals were then classified according to the descriptions of sleep stages as given in the earlier article. The seven stages were numbered from I to VII in order from deepest sleep to lightest sleep or waking

I	A_{1a}
II	A_{1b}
III	B_1
IV	A_2, A_3, B_2
V	B_3
VI	C_2, C_3
VII	C_4, C_5, B_4, B_5

B. Subjects

The subjects were 40 normal, full-term infants from the charity maternity ward of the University Hospital. They ranged in age from 8 hours to 233 hours, those from birth to 24 hours were called one day old, those from 24 to 48 hours two days old, and so forth. There were 24 boys and 16 girls, 14 were colored and 26 white. With six of these infants daily records were obtained for the period they remained in the hospital· thus there were ten daily records for each of four infants and nine daily records for two other infants. The remaining records were all secured from different infants. The number of records obtained for each age group from one day to ten days respectively was 11, 10, 10, 9, 9, 10, 9, 9, 9, and 6, with a total of 92 records containing altogether 8,354 minutes. There were few ten-day records because an infant was usually taken home on the tenth day at the time the record for that day would ordinarily have been secured

C. Results

A graph was made of each of the 92 records: a few illustrative curves are reproduced here. Along the ordinate are placed the sleep

stages from I, or deepest sleep, to VII, or complete waking.[1] Along the abscissa is represented a minute-by-minute continuum from the starting point to the end of the observation period. An interval of deepening sleep is thus shown by a drop in the curve.

FIGURE 1

Boy–White–1 day

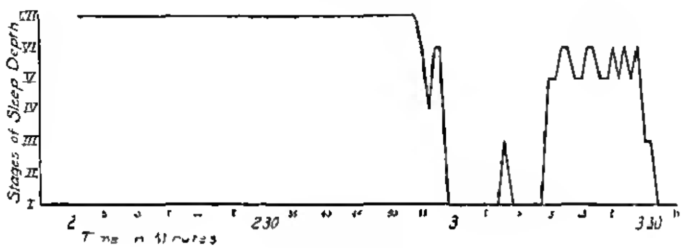


FIGURE 2

Girl–Colored–1 day

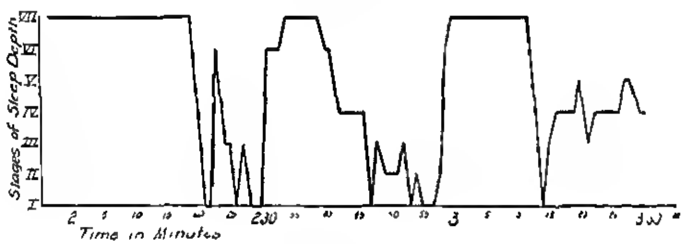
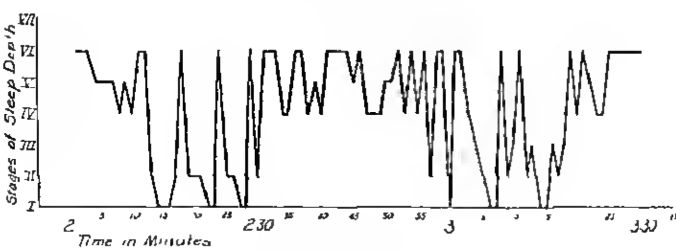


FIGURE 3

Boy–Colored–1 day



FIGURES 1-3

[1]Only six stages are cited by Reynard and Dockeray because they combined my stage *V* with Stage *IV*

Careful inspection of the curves revealed, first of all, that they were quite variable from infant to infant (Figures 1-9) and from day to day in the same infant (Figures 3, 4, 6). Furthermore, there were several different kinds of curves. Over half of the curves (57%) showed a single period of deep sleep, which might occur

FIGURE 4
Boy-Colored-7 days

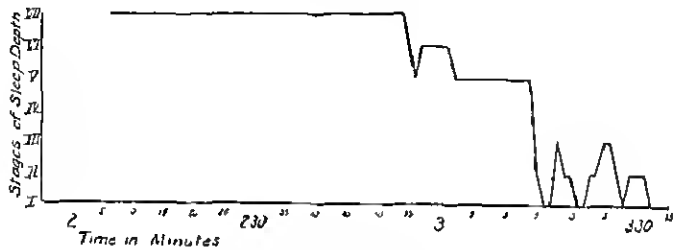


FIGURE 5
Boy-Colored-9 days

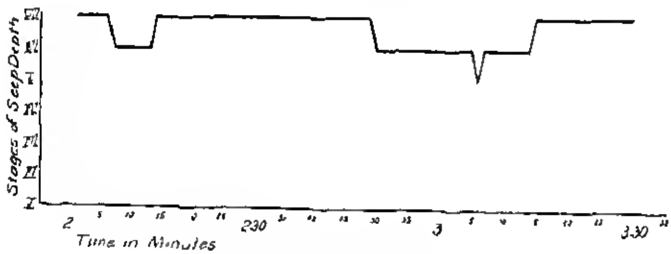
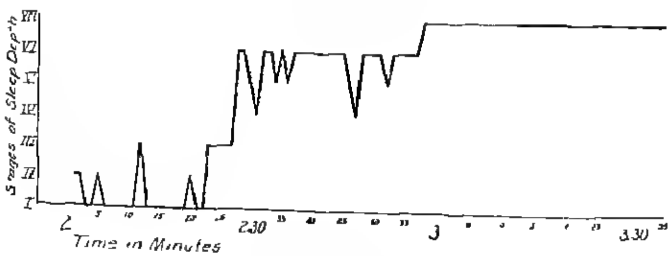


FIGURE 6
Boy-Colored-10 days



FIGURES 4-6

anywhere from the very beginning to the very end of the record (Figures 4, 6, 7, 8). In 28 per cent of the curves there were two such periods of deep sleep (Figures 1, 9), the interval between these two periods ranged from 7 to 51 minutes, with a median of 28 minutes. In 3 per cent of the records there were three periods of deep sleep (Figure 2) In the remaining 12 per cent there were

FIGURE 7
Boy-White -10 days

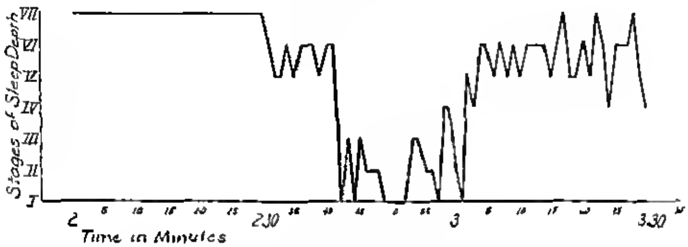


FIGURE 8
Boy-White -10 days

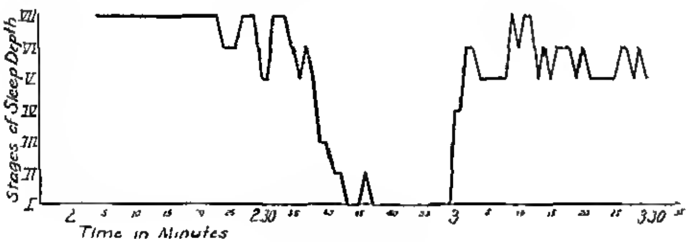
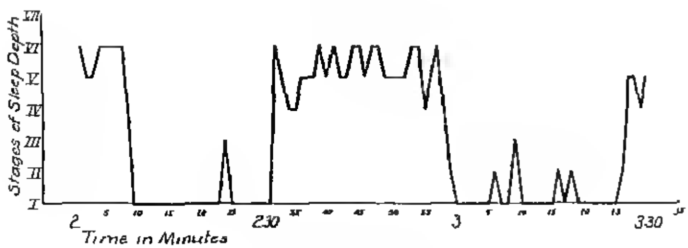


FIGURE 9
Girl-White -10 days



FIGURES 7-9

no instances of deep sleep (Figure 5). in some cases the infant was active and crying the entire period The one- and two-day records showed more instances of two periods of deep sleep than of a single period, this was not true of any subsequent age group The few records where three intervals of deep sleep appeared in each were also obtained from one- and two-day-old infants

The length of a period of deep sleep ranged from 1 to 34 minutes, with a median of 17 minutes, though this interval included more than Stage *I*. It was difficult to decide just where a given period of "deep sleep" began and ended, hence an arbitrary criterion was adopted, whereby Stages *I*, *II*, and *III* were grouped together to represent "deep sleep," and a period of "deep sleep" was measured wherein there were no interruptions for more than two consecutive minutes of stages above *III* No age difference was apparent

In addition to the general shape of the curves, their irregularity of outline should be considered The curves, as Figures 1 to 9 indicate, were by no means smooth, the progression into and out of a condition of deep sleep was quite irregular, nor was there any consistent order of succession of sleep stages involved in such changes

Another factor concerned with such variability is the number of Stage *I* minutes which occurred in an uninterrupted sequence The length of such an unbroken period of "deepest sleep" ranged from 1 to 15 minutes, and there was a slight tendency for the sequence to increase with age, since the average number for the age groups from one to ten days respectively was 5 4, 4 0, 5.6, 5.9, 6 2, 6 8, 7 0, 7.0, 4 6, and 8 5.

This fact suggested that the records decreased somewhat in variability during the ten-day period after birth But a more complete index of variability was needed than merely the sequence of Stage *I* minutes After considering and rejecting a number of complex indices, the writer finally decided on two measures (*a*) the number of changes in direction in a given record (upward versus downward trends) and (*b*) the average number of stages involved in each change Suppose an infant has dropped from Stage *IV* to Stage *III*, and then returns to Stage *V* This direction change includes two stages If the next stage is *VI* or *VII*, there is no change in direction, and the number of stages is not counted. If, however, the stage

following *V* is *II*, there is a direction change involving three stages.

The average number of changes in direction per record for each age group from one to ten days respectively was 23.2, 24.7, 22.4, 13.2, 27.7, 23.5, 22.7, 19.4, 19.6, and 25.7, with a total mean of 20.4. There is evidently no consistent age trend here. However, the average number of stages per change in direction for each age group was 1.8, 2.1, 1.6, 1.7, 1.6, 1.6, 1.4, 1.7, 1.3, and 1.5, with a total mean of 1.6. Here the average for Days 1 and 2 is 2.0, for Days 3 to 7 inclusive 1.6, and for Days 9 and 10, 1.4. In other words, while records for all age groups involved many changes in direction, there was some tendency for the direction changes to decrease in extent during the 10 days after birth. In this respect, then, we could say that variability decreased somewhat with age.

Another question arises as to the relative amount of time spent in each of the stages of sleep. The per cent of the total recorded time spent in each stage from *I* to *VII* respectively was 12.7, 6.2, 5.2, 6.1, 12.9, 16.6, and 40.3. In other words, the infants were sound asleep (Stage *I*) only about one-eighth of the time, and wide awake over three times as much.[1] Now if we group together Stages *I* and *II* for deepest sleep, Stages *III*, *IV*, and *V* for intermediate conditions, and *VI* and *VII* for active conditions, the per cents are approximately 19, 24, and 57. Such findings contradict the layman's casual assumption that the newborn infant spends most of its time sleeping.

The totals cited neglect the factor of variability in individual records. Table 1 shows the per cents for each of the six infants for whom a series of records was obtained. For example, the amount of time spent in Stage *I* ranged from 9.5 per cent to 25.0 per cent

TABLE 1

PER CENT OF TIME SPENT IN EACH STAGE

Infants	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	Total minutes
A	16.9	1.7	2.3	8.6	8.2	20.1	42.3	907
B	25.0	7.3	4.0	5.4	15.6	15.4	27.4	909
C	9.5	4.8	7.2	3.5	11.9	13.1	50.0	911
D	16.3	6.7	2.5	6.7	10.2	23.8	33.8	865
E	10.1	5.4	8.7	6.3	17.2	17.4	35.0	815
F	10.7	7.5	4.3	4.6	12.9	17.8	42.1	905
Total	14.8	5.6	4.8	5.8	12.6	17.9	38.5	5,312

and in Stage *VII* from 27.4 per cent to 50.0 per cent. The total time spent in deepest sleep was slightly greater for these than for the group as a whole (14.8% vs. 12.7%).

Table 2 indicates that there are no consistent age differences, for

TABLE 2
PER CENT OF TIME SPENT IN EACH STAGE BY AGE GROUPS

	I	*II*	*III*	*IV*	*V*	*VI*	*VII*	Total minutes
1 day	14.0	7.0	4.8	8.0	12.3	18.1	35.8	1,008
2 days	9.5	5.6	5.7	5.2	9.5	20.2	14.3	898
3 days	14.2	4.4	5.1	6.0	14.0	14.6	41.7	902
4 days	9.2	4.9	4.7	1.0	8.4	15.6	56.2	834
5 days	15.9	6.9	6.7	8.7	18.6	18.6	24.6	826
6 days	11.1	6.2	5.9	5.6	15.0	17.8	38.3	908
7 days	10.9	7.9	3.8	6.1	16.0	17.9	37.3	806
8 days	13.7	4.5	4.0	7.2	9.0	11.6	49.9	801
9 days	10.3	8.1	5.7	7.0	12.9	14.0	42.0	827
10 days	21.9	6.4	5.1	5.3	14.3	16.4	30.5	544
Total	12.7	6.2	5.2	6.1	12.9	16.6	40.3	8,354

the per cents of each condition are highly variable from day to day. Although the ten-day group shows a high per cent of Stage *I*, there are fewer cases here than in the other groups; furthermore, the nine-day group shows a *lower* per cent than most of the preceding age groups. The per cents cover a wide range, for example, in Stage *I* they range from 9.2 to 21.9, and in Stage *VII* from 24.6 to 56.2. Within any single age group the range of per cents for the various members of that group were frequently even greater than those just cited. In the one-day group, for instance, the per cent of time spent in Stage *I* ranges from 0 to 25.6 per cent, and in Stage *VII* from 0 to 100 per cent.

Still another question concerns the point during the observation period when the infant is most likely to be asleep. We have already indicated the many types of sleep curves to be found in newborn infants. It is possible, however, that mathematical treatment of the data might reveal a slightly greater tendency for infants to be asleep at one point than at another. The data were tabulated in fifteen-minute intervals from 2 o'clock to 3:30, and per cents given to show how much of the total data for each such interval was spent in each sleep stage. This procedure was also followed for each of the six infants who had a series of records.

TABLE 3

PER CENT OF EACH FIFTEEN-MINUTE INTERVAL SPENT IN EACH SLEEP STAGE

	I	*II*	*III*	*IV*	*V*	*VI*	*VII*
2:00-2:15	6.0	1.7	1.6	3.1	6.4	19.2	62.1
2:15-2:30	14.4	6.2	6.1	4.7	10.1	11.9	46.6
2:30-2:45	19.9	9.3	6.3	7.0	10.4	13.7	33.4
2:45-3:00	12.0	7.2	6.6	8.2	16.9	19.8	29.3
3:00-3:15	10.9	7.0	4.9	7.8	16.9	19.1	33.4
3:15-3:30	11.3	5.9	4.5	5.9	18.1	16.7	37.5

Table 3 reveals that for each fifteen-minute interval the largest per cent of the time was spent in waking activity (Stage *VII*), though these per cents range from 29.3 to 62.1. The greatest activity and the least deep sleep occurred in the first quarter-hour, which is what we might expect right after the infant has been disturbed by much handling. The highest per cent of Stage *I*, or deepest sleep, occurred between 2:30 and 2:45, with the next highest per cent in the preceding quarter-hour, though the latter interval had the second highest per cent of waking activity. Even here, however, the highest per cent of Stage *I* is barely one-fifth of the total time recorded for that interval. A similar order as to sleep and activity in the various intervals is observed when we group together *I* and *II*, *III*, *IV*, and *V*, and *VI* and *VII*. When the data are tabulated in terms of three half-hour intervals, we find that the per cents for the intervals following 2:00, 2:30, and 3:00 respectively are 14.2, 24.2, and 17.6 for Stages *I* and *II* and 69.9, 48.1, and 58.4 for Stages *VI* and *VII*. Thus the infant was most likely to be in deep sleep between 2:30 and 3:00 and least likely between 2:00 and 2:30. But even here the infant is fairly active about half of the time in the second half-hour. One would hesitate to say, then, that the sleeping condition of a newborn infant could be predicted with any degree of certainty.

When we examine the data with reference to age groups, we find that the highest per cents of Stage *I* occurred in the fifteen-minute interval beginning at 3:00 for Days 1 and 2, 2:30 for Days 3 to 9 inclusive, and 2:15 for Day 10, the per cents ranging from 17.6 at one day to 43.7 at five days. But we cannot generalize safely that deep sleep occurs earlier in the period as the infant grows older, for when we combine Stages *I* and *II*, the highest per cent for the one-day group is shifted to the 2:15 interval. The

second highest per cent was about as likely to occur in a preceding interval as in a succeeding interval.

Tabulation of the total data does, however, obscure individual trends. For the six infants with a series of records, the highest per cents of Stage *I* occurred in the interval beginning at 2 30 for two of the infants, at 2·45 for one, at 3:00 for one, and at 3.15 for two These per cents ranged from 12 0 to 39.3

A number of incidental factors may also be discussed One of these factors is crying The per cent of the total 92 records which showed crying during each fifteen-minute interval between 2·00 and 3 30 were 30 4, 32 6, 33 7, 38 0, 37 0, and 44 6 Thus, while crying might occur in any of these intervals, it tended to increase somewhat during the observation period, with the most frequent crying between 3 15 and 3·30 The younger infants cried more; 80 0 per cent of the 40 records for infants 1 to 4 days old included crying, in contrast to 59.6 per cent of the 52 records for infants 5 to 10 days old The crying invariably occurred in Stages *VI* and *VII*, when the infant was either awake or very active, most instances happening in Stage *VII* Only occasionally was a possible specific cause for the crying cited In one record of prolonged crying the infant had had a sore navel dressed just before the observation period. In another case the infant had just been circumcised In still another instance the nurse reported that the infant "seemed hungry" and had not taken the usual amount of food

There were 30 hiccough records obtained from 17 infants, in one case there were two hiccoughing seizures during a single period of observation. These records bore out the findings of the writer in an earlier paper (8). Age did not seem a factor. The number of minutes in which hiccoughing occurred ranged from 2 to 22, with a median of 7 In nearly all cases, hiccoughing occurred in Stage *VII*, there were but two cases where it occurred in Stage *VI*, two in Stage *V*, and one in Stage *IV* Beginning with 1·45, the number of cases of hiccoughing which began in each fifteen-minute interval were 5, 10, 6, 7, 0, 2, and 0 Thus one-third of the hiccough periods began between 2 00 and 2·15, and only two occurred after 2 45.

Yawning, sneezing, and regurgitating might occur in any portion of the observation period Yawning, however, occurred most frequently during the first half-hour, and seldom during the last 15

minutes These items occurred most frequently in Stage *VII* and less frequently in Stage *VI* On only two occasions did a yawn occur in any other condition, and that was Stage *V* The frequency of yawning varied from infant to infant and from day to day in the same infant

Defecation—i e, defecation which was audible—likewise occurred only in Conditions *VI* and *VII* It might occur anywhere in the observation period

In a previous article (7) the writer discussed certain types of breathing in the newborn infant which might be called Cheyne-Stokes breathing as in the adult. The number of records for each age group from one to ten days respectively in which such periodic breathing occurred was 1, 0, 1, 1, 1, 1, 4, 2, 6, and 2 Thus it seemed more likely to occur in the older infants. Furthermore, these older infants also showed in any one record more minutes in which Cheyne-Stokes breathing occurred There was one case where 46 minutes of Cheyne-Stokes breathing occurred (6-day-old infant), one of 14 (10-day-old), one of 13 (7-day-old), one of 7 (10-day-old), and two of 5 (7- and 8-day-old) Hence most of the records included only 1, 2, or 3 minutes of Cheyne-Stokes breathing. This type of breathing never occurred, of course, in Stage *I*, in which by definition the breathing was always regular The periodic respiration was found most frequently in Stage *II*, and less frequently in *III*, *IV*, and *V* in that order. In only one instance each was such breathing found in Stages *VI* and *VII* This is to be expected, since the increasing activity of the infant from Stage *III* to Stage *VII* would tend to distort the breathing curve

Further data were secured concerning the frequency of occurrence of the body jerk alone and of the body jerk followed by a general stir, as described in an earlier article (6) Both types of body jerk seemed to occur most frequently during the first three days, decreasing slightly thereafter The per cent of the total number of body jerks which occurred in each stage from *I* to *VII* respectively was 15 6, 24 7, 47 9, 4 1, 1 6, 6 0, and 0 Thus about half occurred in Stage *III*, a fourth in Stage *II*, a sixth in Stage *I*, very few in Stages *IV*, *V*, and *VI*, and none at all in the waking condition The earlier investigation found most of the "spontaneous" body jerks in Stages *II* and *I* respectively, with few in Stage *III*, though it agreed that body jerks decreased as the infant became more active

The per cents of body-jerk-plus-stir for each stage were in the present study 3.0, 9.6, 12.6, 4.5, 5.0, 55.8, and 9.6. Again, while this type of behavior might occur in any condition, it was least likely to occur in deepest sleep and most likely, as stated in the earlier article, to occur in Stage *VI*.

In a few infants additional factors seemed to characterize deep sleep. In two infants slight, periodic "chewing" movements, involving the lower lip or jaw alone, appeared during Stage *I* and disappeared when the breathing became irregular. These slight movements varied in number from one to fourteen at a time. In but one infant was there audible breathing during Stage *I* which was comparable to what we call "snoring" in the adult. This "snoring" likewise disappeared as the infant passed from Stage *I* into Stage *II*. These additional factors would not occur every day in a given infant, but did occur in several daily records for that infant when a series of records was obtained.

Throughout this discussion no sex or color differences have been mentioned, because our findings were always negative. Nor have any reliable sex or color differences been reported in other investigations with the newborn infant.

These findings concerning sleep may now be compared with those of other investigators. As no adequate criterion of sleep has been used heretofore with newborn infants, information about their sleep curves is very scanty. Back in 1892 Czerny (1) determined the sleep curves of children of varying ages by means of the strength of induction current necessary to produce some response in the child. With one 23-day-old child, the youngest used, the maximal depth during a 3-hour period occurred at the end of one hour if the infant were undressed and 1½ hours if the infant were clothed. A child 3 years 8 months old showed two maxima during a 12-hour period, the greater after 1½ hours and the lesser after 10½ hours. Aside from the fact that data were secured from too few subjects, and that the subjects were older than those used in the present study, we might question the adequacy of the criterion used by Czerny.

In 1932 Irwin (3) determined the amount of motility and sleep of infants 1 to 16 days of age in 15-minute intervals from 2:30 to 5:45. He found that 28 per cent were asleep during the first period, 63 per cent during the sixth period (about the middle), and 50 per cent during the last period. Apparently he used "eyes closed,

body quiet" as a criterion of sleep as he did in previous studies No specific sleep curves or individual variations were indicated. The period of observation was much longer than in the present study, we can only speculate as to what our results would have been if our subjects had been available for a similar period

In 1933 Marquis (4), in a study of the motility of 13 infants less than one year of age, used "eyes closed for one minute" as the criterion of sleep. She found quietest sleep occurring at the end of the second hour for night sleep and at the end of the first half-hour for day sleep Infants' sleep, she said, is less sound than that of adults and less variable from night to night Here again no specific sleep curves were given, the infants, too, were older than those of the present study

Reynard and Dockeray (5) constructed a few sleep curves for newborn infants in both minute and five-minute intervals, using the criterion of sleep depth established by the writer. These curves were reported to have an intermediate period of deep sleep in most cases But the period of observation was shorter than that of the present study, and too few of the longer records were secured to indicate the wide variations possible from infant to infant and from day to day in the same infant

A generalized sleep curve for the newborn showing a single point of deepest sleep would at first glance seem to be quite reasonable because it is similar to the sleep curves attributed to adults by various investigators. But there is no reason why we should expect the sleep pattern of the newborn infant to conform to that of the adult before any appreciable learning has taken place. The organization of an infant's day is far different from that of the adult, and different, too, from its own prenatal existence The evidence indicates that the human being must learn to adapt himself to the cycles of quiescence and activity necessitated by his physical and social environment We should not expect much adaptation of this sort to occur in the brief period of 10 days following birth. The extreme variability of neonate sleep from record to record is the most significant feature of the results of this investigation

A more complete picture of the neonate's sleeping and waking rhythms should eventually be obtained by securing continuous records for other intervals of the day and night beyond the one used in this study

D. Summary

A total of 92 continuous records, comprising 8,354 minutes, was secured from 40 newborn infants in the interval between two afternoon feeding periods. These records were classified from minute to minute in terms of seven stages of sleep depth ascertained in a previous study Graphs and statistical analyses yielded the following conclusions

1 Sleep curves in the newborn are highly variable from infant to infant and from day to day in the same infant There may be one, two, or even three periods of deep sleep in a given record, their frequency of occurrence being in the order named, or there may be no deep sleep at all

2 Within this ten-day period there was some tendency for the variability within the individual curve to decrease with age, when measured in terms of extent of direction-change or in terms of the length of an uninterrupted series of Stage *I* minutes No age difference was apparent, however, in the length of the period of deep sleep.

3 For the infants as a whole the relative amount of time spent in each condition would place the stages in this descending order: *VII*, *VI*, *V*, *I*, *II*, *IV*, and *III*. The infants were awake 40.3 per cent of the time and sound asleep only 12.7 per cent of the time Results for the serial records for six infants were similar. No age differences were noted

4 The infant was somewhat more likely to be awake between 2:00 and 2 15 and asleep between 2.30 and 2:45 than at any other time, but there was little difference between per cents for these intervals and the other intervals The six serial records were quite variable in this respect

5. Incidental factors such as yawning, sneezing, regurgitating, hiccoughing, crying, and audible defecation were most likely to occur in Stage *VII*, and never occurred in Stages *I*, *II*, or *III*. Cheyne-Stokes breathing increased somewhat with age, and occurred most frequently in Stage II Body jerks were most frequent in Stage *III*, while body jerks followed by a general stir were most frequent in Stage *VI*. The first type of jerk decreased with age, giving way to the second type

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The Journal of Genetic Psychology, 1939, 55, 137-175

THE DEVELOPMENT OF COOPERATIVE BEHAVIOR IN MONKEYS AND YOUNG CHILDREN*

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A. INTRODUCTION

The present investigation sought to study the origin and development of cooperative behavior in monkeys and young children when these subjects were placed in a situation in which each could secure food for his partner, but not for himself. When cooperative behavior developed under these conditions, we studied the methods of communication by which it was secured and controlled.

Eight monkeys and eight preschool children were used as subjects. The monkeys were studied at the primate research colony of the University of Wisconsin during the summer of 1934. Our thanks are due to Professor Henmon and Professor Harlow for their cooperation in making the facilities of the research laboratory available. The children were studied at the University of Mississippi during the summer and fall of 1935.

Crawford (1) has recently described the cooperative solving of problems by young chimpanzees. His monograph discusses the historical background of the problem, and Crawford's work itself is the only important experimental attack on the problem of cooperation in the sub-human primates. The previous work on children, mostly observational in nature, is available in textbooks (2).

Crawford's study closely resembles the present work in purpose but not in method. Crawford's experiments demanded teamwork for a common goal; for example, a pair of subjects pulled a weighted food box too heavy for either to move by himself. The present experiment demanded a response which brought no immediate reward to the responding subject. But each subject could, in alternation, secure food for his partner. It was theoretically possible for a subject to give food to his partner in the hope that on a subsequent trial the partner would give food to him. The conversations of

*Received in the Editorial Office on September 2, 1938.

some of the children indicated their realization of this possibility. Behavior of this sort is characteristic of much adult cooperation, and if found in children or monkeys it may also be called cooperative.

B. Experiments with Monkeys

The eight monkeys were studied in four pairs with no shifting of partners. Each pair lived side by side in the cages where the experiment was performed. The two wire cages, 18 x 30 x 30 inches in size, were placed end to end, with a nine-inch gap separating them

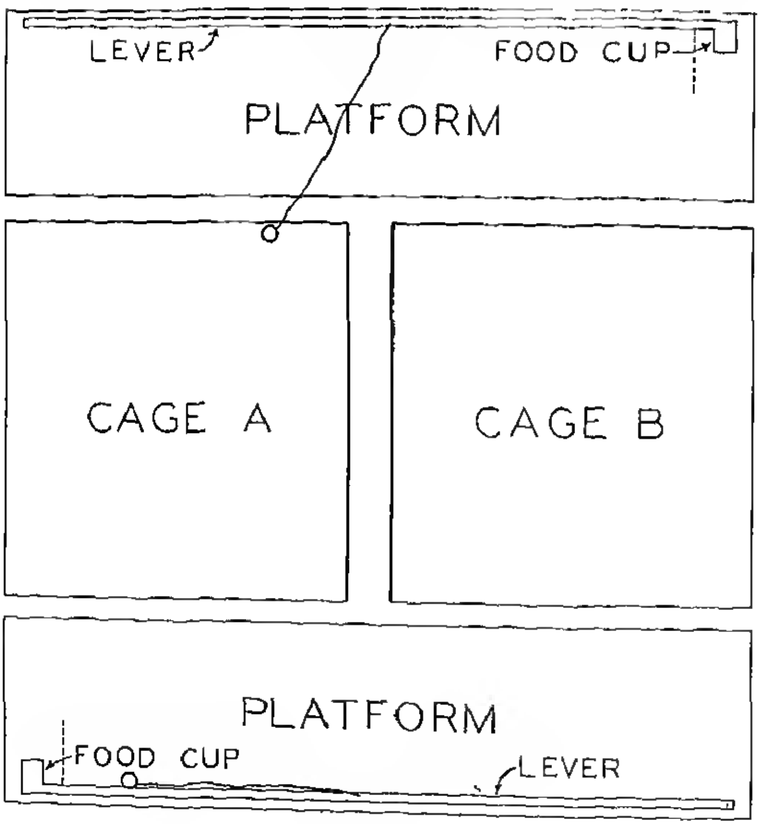

FIGURE 1

The arrangement permitting one subject to pull food to the other is shown in Figure 1. A light and easily moved lever was pivoted at one outside corner of a platform built by the cages. At the free end of the lever a food cup was fastened. A cord was attached to the middle of the lever. A ring on the free end of the cord could be placed in the cage nearer the fulcrum of the lever. The subject in Cage *A* could pull the ring and cord placed in its cage and thereby pull the food cup to Cage *B*. He could not reach the food which he himself pulled in. In the lower part of Figure 1 a similar arrangement is shown which permitted the subject in Cage *B* to pull food to his partner in Cage *A*.

A single grape was used as an incentive on each trial for the monkeys. They were fed their day's rations at the end of the experimental period.

The daily experimental program consisted of 24 trials with *A* and *B* alternately pulling food to each other. The experimenter put a grape into the food cup, placed the ring in the cage, and started the stop-watch. If the subject pulled, the time before pulling was recorded, the apparatus was replaced at the edge of the platform, and the trial for the other subject was begun. If the subject had not pulled the ring at the end of five minutes, the trial was declared over, the ring was taken out of the cage, and the grape out of the food cup. The next trial was then begun for the other subject. Thus, in what will be called the *"food days,"* each subject could receive a maximum of 12 grapes and could pull food to his partner a maximum of 12 times.

After the subjects learned to pull, food days were alternated with days on which exactly the same procedure was followed without food. The experimenter came into the room at the usual time and, without placing a grape in the food cup, put one of the rings in the cage. If the monkey pulled, the time before pulling was recorded. If he did not pull within five minutes, the ring was removed and the next trial begun for the other subject. These are called the *"no-food days."*

The alternation of food and no-food days constituted the basic training. If a subject did not distinguish between the two conditions at the end of 240 trials (20 days of training), he was dropped from the experiment. If a clear differentiation between these two conditions was shown, the following test situations were given.

The first test situation was called the "empty-cage control." One animal was removed from the room and the other tested as before. If the ring was pulled in, the time was recorded, the grape allowed to remain in the empty cage, another one put in the food cup, and a new trial started. If the ring was not pulled in five minutes, the grape was removed, another one placed in the food cup, and a new trial started.

The empty-cage control was designed to distinguish between co-operative pulling and pulling which was motivated directly by the sight of the ring and food without reference to the partner.

The other test situation was named the *"screened-food control."* Metal screens (shown as dotted lines near the food cups in Figure 1) were attached to the two levers. Each screen prevented the pulling animal from seeing the grape in the food cup but allowed the receiving animal to see it.

On half of the trials a grape was placed in the screened food cup. On the other half of the trials a pretense of placing a grape in the cup was made, but the cup was actually left empty; these are called *"fake"* trials. From the standpoint of the pulling monkey the appearance of the apparatus was the same and the behavior of the experimenter the same whether food was really placed in the food cup or not. The two types of trials were given in random order. Trials for the two subjects were alternated.

The screened-food test gave the receiving monkey an opportunity to inform its partner regarding the presence or absence of food, and gave the pulling monkey an opportunity to respond differentially to these cues by pulling only when food was really in the food cup.

C. Results

All eight monkeys learned to manipulate the apparatus and to pull food to the partner. Four of them pulled more slowly or did not pull on the no-food days. But none of them showed any evidence of behavior which could be called cooperative.

1. *Pal and Psyche*

The first pair of subjects consisted of two young adult male pig-tail monkeys, *Macaca nemestrinus,* named Pal and Psyche. Pal pulled immediately on almost every one of his 12 (food) trials on the first day, and continued to pull rapidly throughout the entire train-

ing period. On days when no food was given, Pal was more hesitant, although he eventually pulled on most of his no-food trials His average pulling time fluctuated and then became fairly stable at 45 seconds At the end of 20 alternate food and no-food days, Pal was pulling regularly and almost immediately on every trial on the food days, and less regularly and much more slowly on the no-food days

For the first four days, Psyche pulled about as readily on no-food as on food days After that, he responded differently to the two situations On food days he pulled regularly, with an average time fluctuating around a minute On no-food days he reached a point where he never pulled, he seemed to avoid the ring with a studied disregard Thus by the end of 20 days Psyche had also made the basic differentiation, and the empty-cage control was given to both animals

Pal continued to respond as he had during the last half of the 20 days of the initial training. He pulled on days when food was present, and pulled immediately on practically every trial. On one of the five days of the empty-cage control, no food was used Pal's average pulling time was exactly the same as on the last no-food day when Psyche was present. There were thus no measurable differences in Pal's behavior which could be attributed to the removal of Psyche from the scene

Psyche behaved in a similar manner when Pal was removed and he was left paired with an empty cage On the four food days he pulled with a little more speed than usual On the one no-food day of the empty-cage control, he did not pull at all Again, there were no measurable differences attributable to the absence of the partner If the animals had been cooperating with each other during the first 20 days, they were now just as willing to cooperate with an empty cage

Both animals were given the screened-food control The receiving monkey (who could see the food) was judged in both cases to react differently on food and fake trials On food trials the receiving animal was more interested in the situation and tended to stay in the corner of the cage closest to the food. Frequent attempts were made to reach the food in case it was not pulled in immediately On fake trials, various other types of behavior developed Pal formed the habit of reaching out and slapping the experimenter when he pretended to place food in the cup The protocols for Psyche contain such comments as

> Psyche getting negativistic on many trials when no food is placed for him He very obviously turns his back on the food cup or goes to the other side of the cage Pal pays no attention to this behavior

It seems probable that a person could learn to guess with fairly high accuracy, from observation of the differences in the receiving animal's behavior, which trials had food present and which did not But there was no evidence that the monkeys could learn to interpret their partner's behavior. Pal pulled in less than 15 seconds, food or no food, on 95 of his 96 trials Psyche did not pull quite so rapidly or regularly, but he had an average pulling time of 15 seconds, and this average was the same on the 48 food and the 48 fake trials. Neither animal showed an ability to interpret his partner's behavior as a sign of the absence or presence of food when he, the puller, could not see into the food cup for himself

2. *Spider and Twit*

The second pair of monkeys consisted of two young adult males, a spider, *Ateles geoffroyi*, and a cebus, *Cebus capucinus*

Both pulled readily and rapidly The spider pulled more rapidly on no-food trials than on food trials for the first six days of training After that he showed no discrimination between the two conditions either in pulling time or other behavior Twit, the cebus, pulled equally rapidly on both food and no-food trials

Since neither animal differentiated between the two basic conditions during 20 days of training, no test trials were given

3. *Annie and Percy*

The third pair of monkeys consisted of two young adults, Annie, a female baboon, *Papio hamadryas*, and Percy, a male pigtail macaque, *Macaca nemestrinus*.

Percy pulled with beautiful regularity and absolutely no regard to the question of whether or not food was present. On the average, his 12 daily pulls were made in 12 seconds each, and it was quite impossible to tell from an examination of the pulling times whether food had or had not been used on that day He was not given the empty-cage control test.

Annie completely refused to pull for the first four days, although food was used on all trials On the fifth day she pulled on three,

and on the sixth day on nine of the 12 trials The seventh day was the first no-food day On that day and all subsequent ones she pulled on all trials, with three scattered exceptions occuring on no-food days After the habit of pulling had been established a time difference between the food and no-food days developed and became more marked as the experiment progressed She averaged 11 seconds per trial on the last four food days and about one minute per trial on the last four no-food days

Since Annie had made the basic differentiation, she was given five days of the empty-cage test On the first day she seemed disturbed by Percy's absence and did not pull on four of the 12 trials The protocols contain such notes as

> "Annie kept looking at the door through which Percy had been taken, paid no attention to ring Ring removed at end of five minutes," and "Percy and Annie frequently called to each other from the adjoining rooms"

On the second empty-cage day no food was used Annie pulled immediately on 10 trials and within two minutes on the other two On the third, fourth, and fifth empty-cage days food was again used She pulled immediately on 26 trials and fairly rapidly on nine One trial was unfinished at the end of five minutes

Annie was apparently influenced by the disappearance of Percy on the first day, but after she became accustomed to his absence there were no signs in her pulling behavior of responding differently to the empty-cage control

For the next five days Percy was returned to the experiment and the screened-food test was given both animals. Percy maintained his usual habit of regular and immediate pulling Annie was much more variable in her behavior and pulled slowly or rapidly or sometimes not at all, but without regard to Percy's behavior On one day she pulled more slowly on the food trials, on two days she pulled more rapidly on the food trials, and on two days the averages for the food and fake trials were the same All in all, she failed to demonstrate that her previous behavior had involved any element of cooperation or that she could correctly interpret Percy's behavior as a sign of the presence or absence of food in the apparatus

4 *Kayo and Cwa*

The fourth pair of animals consisted of two three-year-old male monkeys, *Macaca mulatta*, named Kayo and Cwa.

Kayo pulled with clock-like regularity on both food and no-food days No further tests were given

After the fourth day, Cwa pulled fairly regularly and a little more rapidly on the food days than on the no-food days. The difference of half a minute was not large, but was quite consistently maintained.

Cwa was therefore given the empty-cage control He pulled immediately on all but one trial of the first day's series, on all trials of the second day, and on eight trials of the third day The remaining trials for each day were rapid, usually less than one-half minute each. This pulling was faster than that on food days when Kayo was present, and Cwa was judged a failure at demonstrating cooperation

D Experiments with Children

As far as possible the children were treated in the same fashion as the monkeys, but a number of differences necessarily existed. The children did not live in their cages 24 hours a day, but were brought from their homes and placed in them daily for the period of experimentation. They were not experimented upon on Sundays

The cages were 42 x 48 x 48 inches in size and were constructed of wooden frames and wire netting The arrangement for giving food to the partner was similar to that used with the monkeys

In order to keep the children happy and willing to return on the next day, it was necessary to give them some simple playthings Blocks, boards, scissors, paper, and other toys were kept on hand, and one or two things presented each day. Sometimes these toys served as distractors from the problem the experimenter had in mind

Hunger motivation was certainly less strong in the children than in the monkeys The monkeys, fed daily at the end of the experimental period, always ate their grapes immediately The children, brought to the laboratory not many hours after breakfast, sometimes ate the food immediately and sometimes did not Animal crackers instead of grapes were used as the food reward for the children

The practice of giving no food on all trials of alternate days had

to be abandoned for the practical reason that it left the children dissatisfied and unwilling to return the next day As a substitute, trials without food were given for the first half of the day and food trials were given in the latter half

No pair of children was studied for as many days as were the pairs of monkeys The empty-cage and screened-food control tests were given as soon as the children showed clear differentiation in behavior between the food and no-food trials of the basic training

The experimenter refused to talk about the food situation The methods of description and command were therefore original with the children. One exception was made: If a child was at first too polite or too timid to eat his animal cracker without permission, the experimenter said *"You may eat it"* All speech connected with the experimental situation was copied verbatim This task was usually easy, if occasionally something was missed, the approximation was indicated in the record

The children were studied in four pairs with no shifting in partners The experiments will be described in the order of the children's age

E. Results

All eight children learned to manipulate the apparatus and to pull food to the partner Six of them refused almost completely to pull on no-food trials, two of the younger ones did not make as complete a discrimination The two youngest ones failed the screened-food and the empty-cage control tests

1 *Mary and Jimmy*

The oldest children used in the experiment were a boy, Jimmy, and a girl, Mary Jimmy was five years and six months old and Mary was five years and eight months old They seemed about equal in physical skill and general development.

On the first day they were uncertain as to what they should do, what the apparatus was for, and why they were there They were locked in the cages and the following conversation was recorded

> *Mary* "Now what are we going to do? Here's a porch and there's a porch" (Pointing to the two platforms)
>
> *Jimmy* "I'm a lion and you're a tiger" (They play at roaring.)

Mary "What's these?" (Points indefinitely to rings and apparatus Pulls ring in about six inches making it possible for Jimmy to stretch out and get his cracker They play lion and tiger again)

"Why did you put something there and not something there?" (Pointing to the two food cups)

"Jimmy pulls that and I get that and I pull that and Jimmy gets that" (Pointing correctly to the two cords and the two food cups)

"I'm coming out How did you make this? If I were you I'd want some paper" (Children play game of patty-cake through screen)

Jimmy "I'm a white boy, I don't have anything to eat"

Mary "You do have something to eat"

On the second trial, after Jimmy pulled Mary's food cup in, Mary said *"Jimmy, you push that right back,"* and helped him to do so instead of taking the cracker When told that she might eat it, more interest was shown. Each child made correct statements of the problem and each was quite willing to pull food to the other

The first trial of the second day again showed some uncertainty, or perhaps only a lack of hunger. The complete record for that trial is:

Jimmy. "Put one in mine"

Mary "I'll pull yours if you'll pull mine" (They take off shoes and stockings and then try to get out)

Jimmy "I'm going to let you out and you can let me out"

Mary. "Pull that knob, I want to eat mine, hear!" (Jimmy pulls ring and Mary secures cooky at 183 seconds She starts to eat it but does not do so)

"Pull that in so I can put mine back on" (Jimmy pulls lever, which he had pushed out as far as he could reach, in again At the end of five minutes the cracker was still in the food cup)

The remaining trials on the second day all went quite rapidly The time records indicate that on all but two of the remaining 23 trials the cracker was obtained in from two to 10 seconds On the fourth trial of the day Mary pulled the cracker to Jimmy with the command: *"Jimmy, don't eat yours before I eat mine"* Jimmy disobeyed, but ate slowly On some later trials, one of the children

kept his cracker until the partner had one also Then both ate together

On the third day no food was used Neither child pulled on any trial Thus there was a very sharp differentiation between the rapid pulling of the day before and the total refusal to pull on the third day The children asked frequently for crackers and asked why none were present Without dividing the conversation according to separate trials, some of these comments were:

> *Mary* "Now what are we going to do today? Give me a cooky"
>
> *Jimmy* "Cooky, cooky, cooky, looky, looky, looky Do you have any more cookies? When are we going to get a cooky?"
>
> *Jimmy* "Why ain't you going to give us a cooky? Cause you don't have any more?"
>
> *Jimmy* "You ought to give us a cooky or a drink of water"
>
> *Mary* "Are you going to give us a cooky or a drink? When are we going to have a drink?"

After 11 trials neither had pulled They were becoming fretful and the day's work was stopped.

Food was used again on the fourth day. Jimmy pulled rapidly on every trial but one, which took him slightly over a minute Mary pulled rapidly on every trial but two, when she did not pull at all in the five minutes allowed There was not much conversation about the experimental situation, but brief commands to pull were given by the receiving subject in seven of the 20 trials of the day

Jimmy was unavailable for any further trials, and for the next two days Mary was given the empty-cage control test. She pulled an animal cracker into Jimmy's cage on each of the first five trials of the first day Her monologue during these trials contained a number of statements of this order

> "Now how am I going to get mine?" (*Repeated many times*)
>
> "I'm so sorry Jimmy is not here How am I going to get them two cookies?"
>
> "Listen!" (*to experimenter*) "How am I going to get those cookies? Huh?"
>
> "Give me those cookies"
>
> "Give me my cookies, I'm going to get out if you don't give me my cookies"

On the sixth trial for the day she refused to pull. For one hour and fifteen minutes (15 trials) she remained in the cage; touched the ring only once by accident, and made no move to pull. Her conversation included these statements:

> "You give me that cooky or I ain't going to pull it."
> "If Jimmy were here I sure would be thankful, he'd get me out."
> "I want a cooky, please."
> "What's that door shut for? Nobody's in there." (*Pointing to Jimmy's cage.*)

On the second empty-cage day, Mary paid no attention to the ring, never pulled or played with the apparatus; and sat in her cage without making much direct reference to the animal crackers. After half an hour she said, as a cracker was being placed in the food cup for a new trial: *"I ain't going to pull those cookies now."* Later she asked for a cracker and said: *"I ain't going to pull it."* After an hour had passed by without pulling she said: *"I haven't pulled that other cooky yet,"* and laughed.

She made references to cookies in a more general sense. Both Jimmy and Mary had occasionally sung snatches of the popular song *"Looky, Looky, Looky, Here Comes Cooky."* On this day Mary amused herself by singing a number of original variations of these words.

Although the data are not complete, these children were judged linquistically and socially mature enough to make cooperation possible. Each child instructed the other to pull on some trials, and these instructions were always followed. Instruction was frequently unnecessary since the children pulled rapidly without it. Neither child pulled on the no-food trials. Mary stopped pulling crackers to the empty cage after five trials, and found the experimenter rather amusing in persisting in presenting them to her.

A study of their conversation shows that Mary gave instructions, made a rather complete statement of the problem, and bargained with Jimmy about pulling. Jimmy gave instructions and made a fairly accurate statement of the problem involved. He did not try to bargain with Mary directly, but he did attempt some bargaining with the experimenter. For example:

"I want a cooky. Give her a cooky and I'll pull hers in. I'm hungry. I want a cooky."

"Put one on hers. I've got one and she hasn't."

"I won't pull it unless you give me one."

2. *Stanley and Edward*

The second pair of children consisted of two boys, Stanley, age three years and four months, and Edward, age four years and seven months. Stanley was shy and timid and Edward liked to tease him.

On the first day neither child secured a cracker. During the first two trials they sat quietly in their cages, neither talking nor playing. Edward, on the third trial, asked: *"What you doing with these strings in here?"* Later he asked: *"What you going to do with these things?"* Toward the latter part of the period they began to show more interest in the crackers. Stanley declared: *"I'm going to eat those."* They talked about reaching the cookies but did not attempt to do so until the 14th trial when Edward tried to reach his own. On the next trial Stanley took off his shoe and attempted unsuccessfully to use it as a tool with which to scrape in the cracker. On the 17th trial Edward pulled the ring enough to draw Stanley's cup in about two inches. He commented: *"Stan wants that and I don't."* Stanley made no attempt to reach the cracker.

For the first four trials of the second day their behavior was similar to that of the first day. During the third trial Stanley complained: *"I want, a piece of one of them cookies."* On the fifth trial he pulled the cracker within Edward's reach. Edward seemed hesitant about taking it and the experimenter said: *"You may eat it."* Edward took the cooky, played with it, named it, and, after about three minutes, ate it. On the next trial Edward played with the ring for nearly four minutes before pulling it. Stanley snatched the cracker and ate it immediately. Edward complained: *"He's eatin' it up after I gave it to him."*

In all but one of the remaining 18 trials of the day the crackers were obtained. On five trials Edward commanded Stanley to pull. The commands were obeyed on all but one trial. Stanley did not instruct Edward to pull on any trial, but Edward always pulled anyway. Edward then, as at other times during the experiment, teased Stanley by such tricks as the following:

> *Edward* "Look at that! Cooky! Cooky!"
>
> *Stanley* "I can't get it though"
>
> *Edward* "You can't get it unless I pull the string and I'm not going to pull it You want a cooky? *Do you?*"
>
> *Stanley* "Uh-huh"
>
> *Edward* "Look—All the far I'm going to pull it See if you can reach it If you can't I'll give you your money back"
>
> *(Stanley tries but is unable to reach it Edward pulls it closer Stanley gets the cooky.)*

All of the children, but particularly Edward, amused themselves occasionally by making up games centered about the pulling and the food On the 12th trial of the second day Edward pulled the cracker to Stanley with the statement *"Let's play monkey in the cage, you pull in cookies, that's how you play it"* On the seventeenth trial when Stanley was pulling he stopped him with *"No farther! This is the way you play monkey in the cage and get your cookies,"* and reached out to get his. On the twenty-second trial, when he was pulling, he continued the game with *"Monkey in the cage! There you are, there you are, there's your animal"*

With the no-food situation on the third day the children in general did not pull Edward began the day by announcing *"Let's play monkey in the cage. You pull and I eat"* But when the ring was placed in his cage without a cracker in Stanley's food cup he did not pull On only two trials of 20 was the food cup moved As far as can be told it was not pulled to secure food on either occasion The first time, Edward amused himself by winding the cord around the wires of the cage wall. In this process the lever was slowly pulled in. The second time, Edward said *"I want to read the paper,"* and pointed to the paper lining of the food cup Stanley obediently pulled and Edward took the paper

Neither child was satisfied without the animal crackers and comments of this order were frequent:

> *Edward* "Put one of those little animals on Why don't you do it?"
>
> "When are you going to put those elephants on? Huh? Huh? Huh? When are you going to put those animals on? Huh? Tell me! When are you! Do you think I'm just going to stay here?"
>
> *Stanley* "When you going to put the cooky on?"
>
> "Time to go home if you ain't going to put the cooky on"

Throughout the last few trials of the day Stanley became very restless and wanted to leave. On the next day he had a temper tantrum and refused to leave home. It was not until six days later he could be persuaded to come again.

On the food day which followed, Stanley pulled on every one of his 12 trials, Edward on all but one of 12. Edward instructed Stanley to pull on three trials, Stanley instructed Edward on only one trial.

On the fifth day, the first eight trials were given without food and the last eight with food. On the trials without food Stanley pulled only once, and Edward not at all. Both children asked *"When you going to put the animals on?"* On the trials with food both children pulled rapidly and happily. Edward instructed Stanley twice and Stanley instructed Edward once to pull. On one trial Edward remarked, and Stanley echoed, *"I'm playing monkey in the cage."* On the last trial of the day Edward persuaded Stanley to pull with the promise *"You give me the cooky and I'll give it to you."* The promise was not kept.

With food on the sixth day, all 24 trials were completed. Edward instructed Stanley three times and Stanley instructed Edward twice.

On the seventh day 12 trials were given without food and 12 with food. Stanley pulled on one of the no-food trials, Edward on none. All of the 12 food trials were completed. On one of them Stanley told Edward to pull and on three Edward told Stanley to pull.

On the eighth day, with food, all 24 trials were completed. Edward instructed Stanley to pull on four trials and Stanley instructed Edward on seven trials. The complete record of half of this day is given in Table 1 to illustrate the general conversation and the type of instruction given by one child to the other.

Edward and Stanley were judged to have made a clear-cut differentiation between the food and the no-food situations, and to require no more practice. The screened-food control test was given for four days. As with the monkeys, each day's schedule called for 12 food trials and 12 fake trials, with a pretense of placing a cracker. The two conditions were mixed at random except that each child had an equal number (six) of each kind.

The first two trials of the screened-food test happened to be fake trials. Stanley looked at his food cup on the first trial, saw no

TABLE 1

RECORD OF STANLEY AND EDWARD ON HALF OF DAY 8

Food was used on all trials Edward had just had breakfast before coming to the experiment, Stanley was hungry.

Trial No.	Pulling subject	Time to pull	Conversation
1	Stanley	1	*Edward* "Hey, I want something to play with! You got any cookies today?" *Stanley* "I want a cooky" *Edward* "It's not time for it yet"
2	Edward	5	*Edward* "I don't know whether it's on there You never can tell" (Repeats "You never can tell" 16 times in sing-song manner, sometimes laughing)
3	Stanley	5	*Stanley,* as he pulls "There's your cooky" Edward names the cooky
16	Edward	238	*Stanley*: "Going to pull another cooky in" Edward looks to see if there is a cracker. They go on playing *Stanley*· "Pull me a cooky" Edward reaches for ring with toe *Stanley*· "Pull it closer" (tries to get it) *Edward* "Reach up to here." (pointing to shoulder) *Stanley* "Pull it to me" *Edward*· "Unh-unh" *Stanley* "I'll get it with my toes" (fails) *Edward* "Now see if you can get it" (pulling it a bit closer) *Stanley* "Pull it closer" *Edward*· "Lie down on the floor," (to get his arms out farther) Edward pulls and Stanley obtains the cooky
17	Stanley	260	*Edward* "Hey, pull that" Stanley does so immediately.
18	Edward	114	*Stanley* "Pull me a cooky" (repeated four times) *Edward* "Give me two balls, give me two balls, hear?" *Stanley* "Pull me that cooky" *Edward.* "If I pull that cooky to you will you give it to me?" *Stanley* "Uh-huh" *Edward.* "You give it to me and I'll tell you what it is. Will you really?" *Stanley* "Yes" Edward pulls. Stanley gives Edward the cooky He returns it

TABLE 1 (*continued*)

Trial No	Pulling subject	Time to pull	Conversation	
19	Stanley	115	*Stanley* *Edward* *Stanley*	"There's your cooky" (pulls) "Don't have one" "Pull me one, pull me one"
20	Edward	109	*Stanley* *Edward* *Stanley.* *Edward* *Stanley* *Edward*	"Pull me a cooky" (repeated 5 times) "Will you really let me see what it is?" "Unh-unh, I want to eat it" "See if you can get it" "Pull it a little closer" "See if you can get it"
21	Stanley	11	*Stanley*	"Cooky, cooky!"
22	Edward	64	*Stanley* Edward *starts to pull it in gradually, as in trial 20* *Edward*	"Put me a cooky Put me two cookies" "Pull it to me, please" "See if you can get it now"
23	Stanley	55	*Stanley*	"*There's your cooky*"
24	Edward	5	*Edward*	"Let me look at it!" Stanley eats *immediately*

cracker there, and began to play. On the second trial Edward looked at his food cup, saw no cracker there, and demanded *"Give us some cookies, hear, give us some cookies."* On the third trial Stanley failed to notice that food was present Trials 4 and 5 were fake trials On Trial 6 Edward failed to notice the cracker in his food cup for over two minutes and complained Stanley said *"We have some cookies at home,"* and wanted out Then Edward saw the cracker in his food cup and excitedly called to Stanley· *"Pull it, pull that string. Pull it, pull it, pull that string, pull it, pull it, pull it."* Stanley complied On the next trial Edward pulled immediately It chanced to be a food trial and Stanley obtained the cracker. The eighth was also a food trial and Edward demanded *"Come on, come on, pull it, pull that string."* On the ninth trial Edward again pulled, but there was no cracker in the cup The conversation was·

> *Edward* "Stan, I'm getting another cooky" (*pause*) "Stan, get your cooky"
>
> *Stanley* "Which cooky?"

Edward "That one"
Stanley "Which one?"
Edward. "It's gone somewhere. I know that." (*They look for cracker*)
"She just hasn't given you one yet Have you?" (*to experimenter*) "Have you?"

After the discovery that food was present on some trials and not on others, the children tended to pull on the food trials only, but some mistakes were made. Half of the record of the third day of the screened-food control is given in Table 2 It illustrates the type

TABLE 2
RECORD OF STANLEY AND EDWARD ON DAY 3 OF THE SCREENED-FOOD CONTROL
Food was used on trials marked with an x

Trial No.	Pulling subject	Time to pull		Conversation
1x	Edward	309	*Stanley*	"Cooky, pull me that cooky"
			Edward	"Will you let me see what it is?"
			Stanley.	"Uh-huh" (They go on playing At the end of the 5 minute period Stanley repeats "Pull me that cooky")
			Edward	"Give me the legs off that animal and I'll pay you back."
			Stanley:	"O K" (Edward pulls and Stanley gives bits of the cracker to him)
			Edward.	"Hey, give me more, give me the back of him, give me the seat of him"
2x	Stanley	2	*Edward*	"Pull that thing, Stan" (Edward gives Stanley parts of his cracker, as promised)
3	Edward	6	Edward watches experimenter pretend to place cracker and asks "Will you let me see what it is?"	
			Stanley	"Yes"
			Edward	"Really?"
			Stanley	"Yes" (Edward pulls)
			Stanley	"There's nothing there" (Edward looks.)
			Edward	"Let me see. Get out of the way."
			Stanley:	"See, see, see" (Stanley puts his hand in food cup, showing that it is empty, each time with a "See" They push the food box back and talk about getting out)
4	Stanley	10	*Edward*	"Where's the cooky? Huh? Huh? Huh?"

TABLE 2 (*continued*)

Trial No.	Pulling subject	Time to pull	Conversation
5x	Edward	72	*Stanley:* "Pull me that cooky. I'll really let you see what the cooky is."
			Edward: "Will you let me eat it all up?"
			Stanley: "Unh-unh. I'll let you eat the legs up." (Edward teases him by pulling the food cup in very slowly. Stanley gives him small parts. Edward grabbed the whole cracker. Stanley yelled.)
			Edward: "I'll give him back for hollering." (He does so.)
			Edward: "I ain't going to pull you any more cookies."
			Stanley: "I don't care."
			Edward: "I'll get my own cookies." (Edward experiments with empty food box and ring and with his feet.)
			Edward: "Will you give me the cooky if I pull it in?"
			Stanley: "I'll pull you in two and two and two and two and two and two (etc.)."
			Edward: "How much is that, until you get to 100?"
			Edward: "Call Mr. Wolfle and let him get us out."
6x	Stanley	17	Stanley pulled before Edward asked him to. Edward gave him bits of the cooky.
7	Edward	N. C.*	
8	Stanley (pulled 1/3 in) (completed)	113 287	Edward mumbled about "no cookies, no ball." Stanley pulled the ring in while playing with it. Edward looked in the food cup and said "Quit it, Stan."
9x	Edward	5	Edward pulled without Stanley requesting it. Stanley gave parts of the cracker to Edward.
10x	Stanley	26	Stanley pulled before Edward asked. Edward ate all of the cooky.
11x	Edward	5	*Stanley:* "Pull me that cooky."
			Edward: "Give me the two legs."
			Stanley: "There!" (He hands them to Edward who laughs.)
			Stanley: "It's not funny."
12x	Stanley	N. C.	

*N. C. stands for *not completed* in the five minute time allowance.

of pulling instructions given by each child, and a type of payment which Edward occasionally demanded of Stanley—the legs of the animal cracker

A summary of the entire four days of the screened-food control is given in Table 3 The children obtained the crackers in 31 of 44 food trials On 19 trials instructions to pull were given, and these instructions were followed in 18 cases. There were thus 13 trials in which a subject obtained food without instructing his partner to pull The children pulled without reward for either on 16 of 44 fake trials. On six fake trials instructions to pull were given and these instructions were followed in three cases There were 13 fake trials in which a subject pulled without instruction from his partner

TABLE 3

SUMMARY OF SCREENED-FOOD CONTROL—STANLEY AND EDWARD

	Trials with food				Trials without food			
Pulling subject	Instructed to pull		Not instructed to pull		Instructed to pull		Not instructed to pull	
	Pulled	Did not pull	Pulled	Did not pull	Pulled	Did not pull	Pulled	Did not pull
Stanley	11	0	7	5	1	2	5	14
Edward	7	1	6	7	2	1	8	11
Both	18	1	13	12	3	3	13	25

The instruction which the children gave was correct 76 per cent of the time. They obeyed instructions, whether correct or incorrect, 84 per cent of the time. They pulled voluntarily on 52 per cent of the food trials and on 34 per cent of the fake trials for which no instruction was given They gave instructions to pull on only 43 per cent of the food trials, not giving instructions more frequently constituted their chief failure.

Stanley was given two days of the empty-cage control test; Edward was not available for further experimentation On the first trial Stanley pulled the cracker into Edward's cage after five minutes, in the second trial after 15 seconds For the next nine trials he refused to pull Each trial was discontinued after five minutes, a short pause ensued, the food cup was again baited and a new trial started For the most part Stanley played contentedly Once he asked where Edward was Once he announced. "*Now I'm going to*

pull the cooky, pull the cooky" but did not do so. Four times he asked *"When you going to put the cooky on mine?"* Once he declared *"I want two cookies,"* and once *"I want a cooky."* On the twelfth trial he pulled without saying anything, four minutes after the trial began.

Stanley pulled on none of the six trials of the second day. He started out by playing happily with a toy. On the second trial he said *"Give me a cooky. I want a cooky. When you going to put a cooky in here?"* He did not mention cookies again until the sixth trial when he said *"I want a cooky in here."* At this point he hurt his hand and no further trials were given.

Throughout the experiment both Stanley and Edward showed behavior which can be classed as cooperative. They were definitely influenced by the other's presence and instructions. Both children differentiated clearly between the food and the no-food trials of the basic training. During the screened-food test, instructions were given on less than half of the food trials, but these instructions were obeyed in most cases. Stanley pulled on only three of 18 trials on the empty-cage test; Edward could not be given this test.

A study of their conversation shows that Edward gave instructions, made a fairly complete statement of the problem, and bargained with Stanley to get him to pull the cooky in. Bargaining was frequently unnecessary since Stanley pulled quite regularly anyway. Stanley gave instructions and bargained with Edward, but never made a clear statement of the problems involved. His recognition of the screened-food situation was shown by such statements as *"Put a cooky on every time,"* and *"There's not one in there."*

3. *Peter and Robert*

The next to the youngest pair of children consisted of two boys, Peter, age three years and eight months, and Robert, age three years. Peter had superior verbal ability; Robert was the larger of the two.

This pair of children did not begin, as did the others, with a rather fretful period of uncertainty. Peter pulled rapidly on 10 of the 12 trials of the first day. Robert also pulled on 10 of the 12 trials, though not as rapidly as Peter.

Both children seemed to believe that after they had pulled a

cracker to the other one, they deserved it. On two trials, after Peter had pulled the cracker to Robert, Peter claimed it as his own. He asked Robert to give it to him, and after Robert had done so, immediately ate it. Robert protested once by saying, when seeing Peter eating the cracker: *"That's my animal."* After he had pulled a cracker to Peter, Robert usually said: *"I want me one,"* or *"I want me one too."* These statements were sometimes repeated a dozen times on a single trial.

Both showed their training in politeness by occasionally saying *"Thank you"* when the other had pulled the cracker. On some trials this formula was demanded in advance, as illustrated by this conversation:

> *Robert*: "Pull it to me."
> *Peter*: "Will you say 'Thank you'?"
> *Robert*: "Yes." (*Peter pulls and Robert starts eating.*)
> *Peter*: "He didn't say 'Thank you.'" (*Repeated three times.*)

Food was used on every trial of the second day also. Peter pulled rapidly on 11 of the 12 trials. Robert pulled on 8 of 12 trials with time ranging from 17 to 228 seconds. Both children pulled on all trials, 11 in number, for which instructions to pull were given. Saying *"Thank you"* was still demanded, and the request was complied with fairly regularly by both children.

Both apparently understood the problem fairly well but Robert did not give a good verbal description of it. Peter's best statement was: *"He can't get it until I pull it and I'm not going to pull it."*

No food was used on the first eight trials of the third day, and neither child pulled at all. They both showed general dissatisfaction with the lack of animal crackers, said that they wanted them, and, when that produced none, that they wanted to go home. On one trial Robert watched the experimenter put the ring in Peter's cage and said: *"See! See! Look at that chain."* Peter replied: *"There's not an animal cracker in there,"* and did not pull.

Food was used on the last eight trials. Peter pulled very rapidly on three trials and after 49 seconds on the fourth. Robert instructed him to pull only once. Robert pulled on two of his four trials, in 5 and 19 seconds respectively, after Peter instructed him to do so. Robert once refused Peter's command to pull. The conversation was:

Peter "Give it to me Pull it Bob"
Robert "No"
Peter "O K. if you don't pull it I won't eat it. Listen, Bob, if you don't pull it, I won't eat it Do you hear me? Do you hear me? Do you hear me? O K if you don't pull it I won't eat it"

Another note of politeness was introduced when Peter said *"Thank you Say 'You're welcome.'"* Robert replied: *"All right. You're welcome"* After that, both occasionally used this formula

Food was again used on 24 trials of the fourth day Peter pulled on 10 of 12 trials, generally quite rapidly He pulled seven times in response to Robert's requests and three times when Robert had made no request On two trials he ignored Robert's commands to pull Robert pulled rapidly on two trials and slowly on three Peter instructed him to pull three times On the seven trials on which he did not pull, Peter had not instructed him

On the fifth day no food was used for the first eight trials Each child pulled on only one of his four opportunities On Trial 5, after Robert had pulled at the end of 254 seconds, Peter said *"Where is it? Where is the animal cracker?"* Then, looking all around, he added *"I don't see it. You didn't pull it right"*

On the eight trials with food, Peter pulled on one of four opportunities Once he obeyed and once he disobeyed Robert's command to pull Robert pulled on two of four trials, once when Peter had asked him to, and once when no request had been made

Food was again used on every trial of the sixth day Peter pulled very rapidly on nine trials, in 18 seconds on one, and did not pull at all on two trials. He pulled on each of the eight trials when Robert gave instructions Robert did not pull at all on seven trials He pulled fairly rapidly on three, and slowly on two trials Twice he followed Peter's instructions to pull and twice he ignored them On one trial Peter begged Robert to pull the cracker to him without success On the next trial he pulled rapidly for Robert and reprimanded him by saying *"Now Bob, why didn't you pull it? I didn't have any See how nice I am to you?"* Robert grunted assent and Peter continued. *"Well, why aren't you nice to me?"* On the next trial Peter again begged Robert to pull, again without success The conversation was

> *Peter* (*To experimenter*) "Hand it to me, he won't pull it"
> *Peter* "Pull it, Bob, Pull it, Bob Please do Pull it, Bob"
> *Robert* "No."
> *Peter* (*To experimenter*) "He won't pull it Now why don't you hand it to me?"

Peter and Robert were judged in these six days to have discriminated between the two basic conditions The only doubtful point was that Robert did not pull regularly on food days, either with instruction or without it.

The children were given the screened-food control for four days On the first day there were 16 trials Robert instructed Peter to pull on three of the four times when there was food in his food cup Peter obeyed each time In three of the four fake trials Robert gave no instruction and Peter did not pull On the fourth fake trial, Robert imitated the experimenter by pretending to put a cracker in a cup, and then said: *"I want an animal cracker See that thing!"* ("See that thing!" was Robert's most characteristic mode of requesting Peter to pull) Peter pulled immediately. Peter thus had for the day a perfect score for cooperation with Robert's requests, when he himself could not see into Robert's food cup, and Robert did quite well at giving instruction regarding the presence of food

Robert pulled on only one of four food trials On that trial Peter had asked several times that the ring be pulled Robert had replied *"No,"* but finally pulled On the other three food trials Robert once ignored Peter's request to pull and twice Peter gave no instruction In the four fake trials Robert pulled only once, at Peter's request The conversation was:

> *Peter* (*As he sees experimenter pretend to place a cooky in food cup*) "Pull it Bob"
> *Robert* "Animal cracker!"
> *Peter*. "I don't see it I don't see it Where is it Bob?" (*To the experimenter*) "Where is it? Was it just a play-like one?"

Peter evidently recognized that on some trials the experimenter merely pretended to place a cracker in the food cup

Sixteen trials were given on the second day of the screened-food control Peter pulled on all four food trials, each time at Robert's

TABLE 4

Record of Peter and Robert on Day 4 of the Screened-Food Control
Food was used on trials marked with an x

Trial No.	Pulling subject	Time to pull		Conversation
1x	Robert	N. C.		
2	Peter	2	*Robert*	"See that thing." (Pointing to ring on hearing experimenter's finger tap food cup.)
			Robert	"Nothing there."
			Peter	"I want an animal cracker. Mrs. Wolfle, I want an animal cracker."
3	Robert	N. C.	*Peter*	"I want it real. You just played like it, Mrs. Wolfle. I want some. I want some." (Starts crying) "Mrs. Wolfle! Mrs. Wolfle, I want some animal crackers."
			Peter	"I want some animal crackers."
			Robert	"I want some animal crackers."
			Robert	(Later, singing) "I want some animal crackers. Animal crackers. Animal crackers." (Repeated with slight variations, several times by each child.)
4x	Peter	11	*Robert*	"See that thing." (Repeated four times.)
5	Robert	N. C.		Peter is singing and does not watch experimenter.
6	Peter	2		Peter watches experimenter pretend and pulls. Robert looks underneath and all around cage, feels carefully in food cup.
7x	Robert	28+	*Peter*	"Pull it, Bob. Pull the string."
			Robert	"No."
			Peter	"Why? I like it. I like the animal cracker."
			Robert	"Unh-unh."
			Peter	"Please pull it, please do."
			Robert	"No. No!"
			Peter	(crying) "I'm going to hit you again, Bob. I'm going to hit you. Please pull it, please do, Bob. Please pull it again, Bob!" (Peter hits Robert through the wire partition. Robert cries.)
			Peter	"Mrs. Wolfle, hand that animal cracker to me. I'm sorry, Bob. Please pull it."
			Peter	"O. K., I'm not going to let you play with my red wagon. I'm not going to let you eat any apple."

TABLE 4 — (*continued*)

Trial No	Pulling subject	Time to pull	Conversation	
			Robert	"I'm not going to let you have any apple when I have some"
			Peter	"Please pull it, please do Please pull it Please pull it. Please Please!"
			Robert:	"I'm not going to give you any of my apples"
			Peter	"Don't you like me?"
			Robert	"Unh-unh"
			Peter	"Well your mother will give me some She'll turn you over her knee and spank you if you're sassy to me" (Robert pulls)
			Peter	"Where is it? Oh, here it is Thank you Bob"
			Peter:	"Are you going to give me an apple?" (They discuss giving apples, Peter promising to pull an animal cracker for Robert if Robert will give him an apple, otherwise, Peter says: "I'll pull in yours for you like you do for me")
8x	Peter	6	*Robert*	"Pull it! Pull it!" (Peter obeys)
			Peter	"Now are you going to give me an apple?"
			Robert	"Unh-unh"
			Peter	"Then you told a story Telling stories is not giving me an apple The old bad man made you tell a story He won't get you if you give me an apple Will you give me an apple?"
			Robert	"Uh-huh" (Both laugh and begin playing cheerfully)
9	Robert	N C.	Both children play	
10x	Peter	11	*Robert*	"See that thing" (repeated 4 times, Peter pulls)
			Peter	"Are you going to give me that apple?"
			Robert	"Unh-unh"
			Peter.	"O K, you told me a story again Don't you like me?"
			Robert:	"Unh-unh."
			Peter	"You like me when we're playing Why don't you like me now?" (Peter coaxes Robert to promise an apple, and both watch experimenter pretend to place cracker in the food cup for the next trial)

TABLE 4 — (*continued*)

Trial No	Pulling subject	Time to pull		Conversation
11	Robert	7	*Peter*	"I'm hungry right now, did you know that?"
			Robert	"Pull it for you."
			Peter	"Where has it gone? Mrs. Wolfle, why didn't you put a real one in there? Mrs. Wolfle! Mrs. Wolfle! Mrs. Wolfle! (yelling) I didn't want a play-like one. I'm going to take a stick and when I come out I'll hit you with it. I wish . . ." (plays with food cup)
12	Peter	2	*Peter*	"Put a real one in there. If you don't put a real one in there I'm going to hit you." (pulls) "I want *a real one* next time, hear? Get it, Bob."
			Robert	"There's not one there."
			Peter	"I want an animal cracker, Mrs. Wolfle."
13x	Robert	89	*Peter*	"Put a real one in there this time, Mrs. Wolfle. Put a real one in there. (laughs when he sees the cracker) Pull it, Bob. Aren't you going to pull it?"
			Robert	"No."
			Peter	"I'm hungry, Bob. Pull it Bob." (cries)
			Peter	"Pull it, Bob, pull it. I'm not going to play with you. (cries) I'm going to hold your hand and not going to let you see the rats. Please pull it, Bob, pull it."
			Robert	"I'm *not* going to pull it." (pulls it in)
			Robert	"There's not one in there."
			Peter	"See." (holds up animal cracker)
14	Peter	2		Peter pulls, Robert looks to see if animal cracker is there.
			Peter	"Nothing in there." (cheerfully)
			Robert	"Nothing in there." (cheerfully sung)
			Peter	"No, nothing in there." (sung)
15x	Robert	N. C.		They continue to sing.
16x	Peter	7	*Robert*	"See that? See that thing?" (Peter pulls)

request. On the four fake trials Peter did not pull on his own initiative and Robert made no requests. Peter thus had a perfect score for cooperation and Robert a perfect score for correct instruc-

tion With Peter's crackers the pair did not do so well Robert complied with one of Peter's two requests and pulled twice when Peter had not instructed him

The record of the fourth day of the screened-food control is reproduced in full in Table 4 to illustrate the behavior of these children On this day Peter pulled four times, each time at Robert's request On the four fake trials Peter pulled once at Robert's request and three times without instruction Peter exhorted the experimenter not to make it a play-like one Robert followed instruction better than on other days On the food trials he pulled twice at Peter's request and did not pull on the two trials when not requested He pulled once on a fake trial after Peter said he was hungry, *although Peter gave no direct command to pull*

A summary of the entire four days of the screened-food control is given in Table 5. The children obtained the cracker in 20 of 32

TABLE 5
SUMMARY OF SCREENED-FOOD CONTROL—PETER AND ROBERT

Pulling subject	Trials with food: Instructed to pull		Trials with food: Not Instructed to pull		Trials without food: Instructed to pull		Trials without food: Not Instructed to pull	
	Pulled	Did not pull	*Pulled*	*Did not pull*	*Pulled*	Did not *pull*	*Pulled*	Did not *pull*
Peter	4	2	3	7	2	0	2	12
Robert	13	1	0	2	4	0	3	9
Both	17	3	3	9	6	0	5	21

food trials On 20 trials instructions to pull were given, and these instructions were followed in 17 cases There were thus only three trials in which a subject obtained food without instructing his partner to pull The children pulled without reward for either on 11 of 32 fake trials On six fake trials instructions to pull were given and these instructions were followed in all cases There were five fake trials in which a subject pulled without instruction from his partner

The instruction which the children gave was correct 77 per cent of the time They obeyed the instruction given, whether correct or incorrect, 89 per cent of the time They pulled voluntarily on 25 per cent of the food trials and on 19 per cent of the fake trials for which no instruction was given They gave instruction to pull on

only 63 per cent of the food trials. Though this is their chief failure, it is a higher percentage of instruction than that of the older pair, Stanley and Edward.

Each child was given two days in the empty-cage situation. Peter pulled on 18 of 20 trials on the first day and on four of 12 trials on the second. He spent the first day in tearful begging. On the first trial, when he pulled in 10 seconds, he said:

> Where? Where? Mrs. Wolfle, Mrs. Wolfle, suppose you get me that animal cracker. (*cries*) I want the animal cracker. I want the animal cracker. I want the animal cracker.

The monologue continued along this line, with attempts to control the experimenter with threats of not returning, with names, and with tears. On Trial 18, after pulling immediately, he said:

> Mrs. Wolfle, Mrs. Wolfle. I'm not going to pull this any more cause you won't give me those animal crackers. I'm not going to fool with you, you mean thing.

On the nineteenth trial he abided by this resolution until three minutes and thirteen seconds had passed, but then he pulled, and said:

> Mrs. Wolfle, Mrs. Wolfle, I want an animal cracker. Mrs. Wolfle, I want an animal cracker. Mrs. Wolfle, Mrs. Wolfle, give me an animal cracker. She won't talk to me. Mrs. Wolfle, get me those animal crackers. Did you know you hadn't given me one bit of anything to eat? When you open that door I'm going in and eat them.

On the second day he stopped pulling for the most part, though the four trials when he did pull were scattered over the 12 trials given. He did not stop entirely as did Mary and Stanley. He did not talk about the crackers at all.

Robert pulled on two of nine trials on the first day and on none of nine trials on the second. Robert's two pulls, like Mary's and Stanley's, were made when he was new to the empty-cage situation. The record for the first four trials is given in Table 6. After these trials Robert never pulled again, and spent the time in contented play. Six times, on various trials of the second day, he made the statement "*I want an animal cracker.*"

In summary, both Peter and Robert showed behavior which can be classed as cooperative. They were definitely influenced by the

TABLE 6

RECORD OF ROBERT ON PART OF DAY I OF THE EMPTY-CAGE CONTROL

Trial No	Time to pull	Conversation
1	72	"Whose animal cracker?" (to experimenter) "Whose animal cracker?" (pulls) "Listen, whose animal cracker?" (repeated three times) "Listen, listen!" (sings) "Pull it, pull it, pull it, pull it."
2	N C	"I want an animal cracker. I want that animal cracker." (As the cracker was being removed from food cup to start the next trial) "I want it, I want it, I want that."
3	4	"I want it, I want it." (As experimenter takes out ring) "I want an animal cracker."
4	N C	"I want it. Let me have it. I want an animal cracker." "I'll build a house." (plays contentedly)

presence of the other child and by his verbal instructions, commands, promises, threats, and entreaties. Robert failed to pull regularly in the basic experiment, but he issued regular instructions, usually correct, in the screened-food control. He quickly refused to pull in the empty-cage control. Peter was more adept in language, giving definite instruction to Robert, and making statements of the basic problem and of the problem of the screened-food control. He usually pulled when instructed. He did not always offer instruction about his own crackers. The problem of the empty-cage situation was met by pulling rather regularly on the first day, and only one-third of the time on the second day.

4. *John and Vernon*

The youngest pair of children consisted of two boys. Vernon was two years and eight months old and John was two years and six months old. John was shyer than Vernon, who was quite small for his age and poor in coordination.

This pair obtained the cracker on eight of 16 trials on the first day. Both were timid at the start, but both were interested in the crackers. On the first trial Vernon said *"What is that? I want that. I want the tiger. Well, I want the tiger."* John did nothing about Vernon's desires, but started to cry. Vernon did not pull on

the second trial and John said nothing On the third trial Vernon was more specific in his request, saying *"I want that I want that, hear? Get it for me"* Again John did not pull On the fourth trial Vernon pulled the cracker to John while repeating *"I want one, I want one"* Thereafter Vernon pulled on every trial of the day except the last John talked little but on two trials said: *"I want my cake,"* which might be interpreted as instructions to Vernon Vernon was somewhat more explicit in instructing John, using on the last six trials such phrases as *"I want my cake, move it over here."* John pulled on only two of these six trials.

On the second day each child pulled on 11 of 12 opportunities The two exceptions were the twenty-second and twenty-third trials, when they were not very hungry John pulled so rapidly that there was no necessity and little opportunity for Vernon to instruct him Usually the cracker was in Vernon's hands in from two to five seconds after the ring had been placed in John's cage Vernon pulled somewhat irregularly and twice John gave him simple instructions On Trial 7 John used a phrase, *"Look at that,"* which became his most frequent method of asking Vernon to pull On the twenty-first trial Vernon did not pull immediately This conversation occurred:

> *John* "Pull it, pull that right now" (*Vernon paid no attention*)
>
> *Vernon* "I want another cooky"
>
> *John* "I want another cooky I want another cooky"
>
> *Vernon* "I want a lion" (*repeated endlessly*)
>
> *John* "I want a lion" (*repeated endlessly*)

Finally, after five minutes, Vernon saw the ring and pulled, John obtained the cracker

No food was used on the first eight trials of the third day. John pulled twice and Vernon once On the first trial each said *"I want a cake"* Vernon did not pull. On the second trial John watched the experimenter reset the apparatus (without food) and pulled immediately, but slowly and hesitantly. The conversation at that time was this pair's nearest approach to making a verbal statement of the no-food situation

> *Vernon* "That hasn't got any"
>
> *John*: "Huh?"

> *Vernon* "That hasn't got any cakes in it"
> *John* "Huh? Want some cake"
> *Vernon* "I want a cake"

Twelve trials were given with food during the latter part of the day. On the first trial the food was not noticed and Vernon did not pull On the second trial John pulled, Vernon found the cracker and laughed and called it a lion The next three trials were unfinished, but from then on each child pulled regularly and usually quickly

Food was used again on all trials on the fourth day John pulled in less than 14 seconds on every trial, making instruction from Vernon unnecessary. John's usual habit was to stand by the side of the cage where the ring was inserted and put out his hand for it before it was placed within his reach He behaved in this respect like the monkeys and not like the other children Vernon pulled on eight of his 12 trials in times which varied from a few seconds to a minute On two of these John instructed him He said *"Look at that,"* to which Vernon replied *"What is it?"* John answered *"It's a cooky,"* the question and answer were repeated, and then Vernon pulled As his other instruction to Vernon, John said *"Look at that. Look at that Look at that Look at that there See that thing Look at that"* Vernon answered *"I did, I said,"* and pulled John gave this type of instruction on one trial when Vernon did not pull, but asked *"Why?"*

On the fifth day no food was used on the first eight trials John pulled on one and Vernon on two of these trials There was little conversation about food but both looked carefuly at the food cup from time to time. On one trial when Vernon pulled, John reached into the food cup and pretended to take out a cooky and eat it

Eight food trials followed. John pulled very rapidly on all four opportunities Vernon pulled once after instruction from John, who said only *"Look at there"* Twice John gave instructions which Vernon did not follow He said on one trial *"Looky here!"* and then later *"You get that right there"* On another trial he said:

> You get that right there Look at that thing I want to get my cake I want my cake My cake (*more plaintively*) I'll hurt you I'll hurt you

On his fourth trial Vernon did not give John a chance to ask for

TABLE 7

RECORD OF JOHN AND VERNON ON PART OF DAY 6
Food was used on all trials

Trial No	Pulling subject	Time to pull	Conversation
1	John	2	
2	Vernon	189	John looked at cracker, then looked at Vernon immediately Vernon pulled when he saw the ring *John* "What is that?" *Vernon* "I want that, I want a cooky"
3	John	2	*Vernon* "I want a lion What is it?"
4	Vernon	2	
5	John	2	
6	Vernon	3	*Vernon* "I want some I want some"
7	John	3	
8	Vernon	N C	John saw the cracker placed, but Vernon said "You go to sleep and let me wake you up," and they played this game, alternately being the sleeper John watched removal of cracker without saying anything
9	John	2	Vernon did not eat the cracker
10	Vernon	N C	John looked at cracker Looked again Said something vaguely to Vernon (not definite instructions) At 3 minutes Vernon found his own cracker, broken in the meantime *Vernon* "What is that?" *John* "Cooky" *Vernon* "Do you want any?" *John* "Uh-huh" (Vernon handed a crumb or two to John)
11	John	87	*Vernon* "Jump that to me" (repeated five times)
12	Vernon	5	*Vernon* "I want some Give some to me, some cake"
13	John	2	John had his hand ready when ring was inserted Vernon ate immediately
14	Vernon	N C	John looked at cracker and at ring He looked again at the cracker at about one minute He looked again at cracker at four minutes, and tried to reach it Vernon paid no attention

the cracker but said, *"Let me jump it to you,"* and pulled very quickly so that the cracker flew out of the food cup and onto the floor of John's cage. On later days of the experiment Vernon used the expression, *"Jump it to me,"* several times in instructing John to pull.

On the sixth day food was again used on all 24 trials. John pulled almost immediately on every trial but one. On that occasion he pulled in 87 seconds and Vernon spent the time asking for the cracker. Vernon pulled on only six of 12 trials, but John gave no instructions at all. The complete record of part of this day is given in Table 7. In the course of the conversation Vernon still expressed the idea that the cracker which he pulled should be his. John never said this at any time.

John differentiated clearly between the food and no-food situations of the basic training. After the first day he pulled on practically all food trials and on less than half of the no-food trials. Vernon's differentiation was much more ambiguous. He pulled on most of the trials of the first two days; after that he pulled on about half of the food and about half of the no-food trials. Both children were given the screened-food and empty-cage controls.

Three days of the screened-food control were given. John pulled at every opportunity on the first day, Vernon on three of his 10 opportunities. John completely failed to instruct Vernon verbally. On three trials he stood by the corner of the cage nearest the food cup and looked at the cracker, then went to the side of the cage closest to Vernon and looked at him. This behavior was ineffectual, for Vernon did not pull. The only instruction given by Vernon was a statement, *"I want some,"* made as the experimenter pretended to put a cracker into his food cup on a fake trial.

The second screened-food day was something of a repetition of the first. John pulled rapidly on all but one trial, and not at all on the other. Vernon pulled on only two of eight opportunities, when he happened to see the ring as the experimenter put it in his cage. John attempted to instruct Vernon on only one trial when he said: *"Look at that! Look at cooky."* When Vernon failed to pull, John added: *"I don't want it."*

Most of the time was spent in play and a certain amount of fussing. On one trial this conversation was recorded after John pulled. Though very indefinite, it is their nearest approach to a verbal statement of the problem.

Vernon "There isn't anything in there"
John "Uh-huh"
Vernon "There isn't anything in there!" (*yelling*)
John "Uh-huh, some ice cream"

On the third screened-food day John again pulled regularly on every opportunity Vernon pulled on only one of eight trials John usually pulled rapidly, but on one trial he was slower and Vernon offered this instruction

> "Jump it to me Jump it to me Jump it to me Jump it to me Other day I eat some, so give me that one Do something!" John pulled

A summary of the entire three days of the screened-food control is given in Table 8 The children obtained the cracker in 17 of 26

TABLE 8

SUMMARY OF SCREENED-FOOD CONTROL—JOHN AND VERNON

	Trials with food				Trials without food			
Pulling subject	Instructed to pull		Not instructed to pull		Instructed to pull		Not instructed to pull	
	Pulled	Did not pull	Pulled	Did not pull	Pulled	Did not pull	Pulled	Did not pull
John	2	0	11	0	0	0	12	1
Vernon	0	1	4	8	0	0	3	10
Both	2	1	15	8	0	0	15	11

food trials On three trials instructions to pull were given, and these instructions were obeyed twice There were thus 15 trials on which a subject obtained food without instructing his partner to pull The children pulled without reward for either on 15 of 26 fake trials Instructions to pull were given on only 12 per cent of the food trials This percentage is smaller than the corresponding one for the other children

Table 8 shows how completely John and Vernon failed the screened-food test They both failed to give instruction John kept up his habit of pulling almost immediately on practically every trial, Vernon pulled even less often than he had during the earlier part of the experiment

Before the introduction of the empty-cage control the children were given one normal day with the food cups visible to both chil-

dren and with food used on every trial John had been pulling so rapidly that Vernon had little if any opportunity to instruct him But on this day John pulled more slowly on some trials and Vernon twice asked him to pull The instruction on one trial consisted only of saying: *"Jump it to me."* On the other trial the following conversation occurred:

> *Vernon* "Jump that to me Jump that to me I want that I want that I want that Jump that cake to me Please do, hear?"
>
> *John* "No"
>
> *Vernon cried and whined* "Jump it to me."
>
> *John* "Uuh-uuh"
>
> *Vernon* "Please do, please do, please do, please do Jump! Jump! Jump! Please do" (*Vernon continued while John pulled very slowly*)

Vernon pulled on eight of his 12 trials On only one of these trials did John ask him to pull, saying then: *"I want my cake"* Vernon pulled immediately John did not instruct him on any of the four trials when he did not pull

John was given one day and Vernon two days in the empty-cage situation. Both children were judged as failing the test John had 24 trials on his one day He pulled the cracker into Vernon's empty cage on every trial The pulling was usually immediate and never required over 15 seconds John played happily, talked about the crackers, and tried to count the mounting pile in Vernon's cage, but never stopped pulling

Vernon was given 12 trials on each of two days On the first day he pulled on seven of the 12; on the second day on five of the 12 Both the pulling times and the number of trials on which he pulled were similar to the records of the days when John was present Vernon said very little during these two days The longest monologue occurred after he had pulled on the fifth trial of the first empty-cage day It was

> I want to come out Give me a lion now I want in his house I want some of that over there, hear?

In summary, neither John nor Vernon exhibited behavior of the cooperative kind shown by the older children John clearly differentiated between the food and no food situations of the basic train-

ing, but fell down on the screened-food and empty-cage controls His behavior under these conditions was essentially similar to that shown in the first part of the experiment Vernon differentiated poorly between the food and no-food conditions of the basic training and responded to the screened-food and empty-cage controls no more adequately than did John

A study of their conversations shows that instructions to the partner were given quite infrequently Neither did much bargaining, and neither gave an adequate statement of the problem involved in any of the three situations

F Summary

Four pairs of monkeys and four pairs of young children were trained in a situation in which each could pull food to his partner He could secure food only by having his partner pull it to him On some days the food was not placed in the apparatus in order to test the subject's interest in manipulating the apparatus itself

All subjects readily learned to pull food to the partner Four of the monkeys discriminated between the presence and absence of food by pulling more regularly or more rapidly for food The five oldest children discriminated between the two situations by consistently refusing to pull when food was absent Two of the three youngest children, one at the age of three years and the other at two years and eight months, failed to make a complete discrimination in this manner The failure consisted largely in not pulling when food was present The youngest subject, two and one half years old, made the discrimination'

In the screened-food test the receiving subject could see whether the experimenter had actually placed food in the food cup or had merely faked doing so The pulling subject could obtain this information only by correctly interpreting his partner's behavior or by receiving instruction from him.

The screened-food test was given to four monkeys They failed completely to differentiate between the food and the fake trials

The screened-food test was given to six children, the two oldest ones not being available for it Instructions to pull were given on 43 per cent of the food trials by one pair, of ages four years and seven months and three years and four months, in 63 per cent of the cases by the next pair, of three years and eight months and three

years, and in 12 per cent of the cases by the youngest pair, of approximately two and one half years The lack of instruction to the partner was on the whole the chief failure in the screened-food test, for the children usually complied with the instructions which were given The two older pairs obeyed in 84 per cent and 89 per cent of the time The two younger children obeyed 67 per cent of the time, but this percentage is based upon three cases only

The two youngest children failed to give verbal instructions and without these, they acted as they had been accustomed to doing one pulled about 33 per cent of the time and the other immediately and all the time

On the empty-cage control a subject was offered an opportunity to pull food, if it would to an empty cage The four monkeys who had discriminated between the presence and absence of food in the apparatus were given this test They pulled food as regularly (with one temporary exception) to an empty cage as to their partners

The empty-cage control test was given to six children ranging in age from two and a half to five an a half years The two youngest failed the test They pulled according to their usual habits The four older ones all pulled on some trials, but none pulled on all trials The typical behavior consisted of pulling on the first few trials and not thereafter

The older children, throughout the experiment, gave much more specific instruction than the younger ones Where the older ones commonly used such requests as *"Pull it," "Pull me a cooky,"* or *"Pull that string,"* the most characteristic requests of the three youngest children were. *"See that thing," "Look at that,"* or *"I want my cake,"* and *"Jump it to me"*

Formal language was the important type of behavior in securing and controlling the partner's cooperation. The monkeys could not talk and showed no signs of cooperation. The youngest children could not talk well and showed only slight indications of cooperation The older children talked fluently and secured ready cooperation Neither monkeys nor children gave any evidence of developing or using any vocal or gestural substitutes for the formal language which seemed to be the necessary basis for the development of cooperation in this experimental situation

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The Journal of Genetic Psychology, 1939, 55, 177-195

THE CENTRAL NEURAL ORGANIZATION OF OPTIC FUNCTIONS RELATED TO MINIMUM VISIBLE ACUITY*

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A INTRODUCTION

Previous experimental studies (Smith, 13, 14) of the visual defects produced in cats as a result of cortical operations have shown that minimum separable acuity, as indicated by optically induced nystagmic reactions to a moving striated pattern, is not significantly lowered when the optic projection areas of the cerebral cortex are removed In these experiments, the attempt to measure the actual minimum separable threshold of cats before and after removal of the occipital lobes was not completely successful, since with the method used it was impossible to obtain striated patterns of alternate black and white lines which would subtend a visual angle smaller than 11 minutes of arc In order to extend these observations on visual acuity, the determination of minimum visible acuity has been employed One purpose of the present study is to describe certain results which have been secured relative to the minimum visible acuity of cats after complete extirpation of the striate areas of the cortex

These experiments concerning the effect of removal of the visual centers of the cortex upon visual acuity have an important bearing upon theories of organization of visual pattern functions within the central nervous system Since the observations of Hitzig (2), Minkowski (7), and Munk (8), the fact has been known that destruction of the occipital lobes of the cortex in the cat, dog, and monkey produces a permanent inability of the animals to fixate and pursue with the eyes objects held and moved in the field of vision. Recently ter Braak (1) has shown that movement of single objects across the visual field produces nystagmic reactions in normal dogs and monkeys, but that these nystagmic responses to single objects are abolished when the occipital lobes of the cortex are destroyed The results of the experiments cited above (Smith, 13, 14), which have

*Received in the Editorial Office on September 3, 1938.

shown that the minimum separable acuity of the cat does not change markedly after removal of the occipital lobes, raise the question as to the explanation of the defects in optical pursuit in relation to single objects moved in the visual field. Evidently the disturbance is not explicable in terms of a reduction in minimum separable acuity. Thus a second purpose of the present study has been to determine in what way such deficiencies in visual fixation and pursuit are related to minimum visible acuity in cats following complete extirpation of the striate areas of the cortex.

B. Experiments

1. *Apparatus and Procedure*

A diagram of the apparatus employed in the experiment is presented in Figure 1. This apparatus, which is a modification of rotating drums described in previous studies (Smith, 11, 13, 14), is constructed so that a series of single lines may be moved slowly at a uniform rate across the visual field of the subject when it is located in a restraining box on the inside of the drum. No moving part of the apparatus is visible to the subject except the lines moving before its eyes.

The apparatus consists of a large rotating cylinder, 136 cm. high and 122 cm. in diameter, which is mounted on a turntable constructed from an automobile wheel. A wooden support 10 cm. square is mounted on the outer edge of the turntable. Approximately 120 cm. above the surface of the turntable a circular frame, cut from plywood, is attached to this support by heavy braces in such a fashion that the outer circumference of the frame is directly above the edge of the turntable. Small nails are driven into the edges of the turntable and of the upper circular frame, spaced at regular intervals of 2.5 cm. Threads of various diameters may be stretched vertically between these nails in order to provide the stimulus patterns for a type of minimum visible acuity measurement.

A heavy rod suspended from the ceiling of the experimental room supports within the drum a small platform, which is mounted about 30 cm. above the surface of the turntable. This platform is made sufficiently large to support the box-holder which restrains the animal. Two large semicircular screens are mounted on the support rod near the top and the base of the drum to shield from the subject's view the edges of the turntable and of the upper cir-

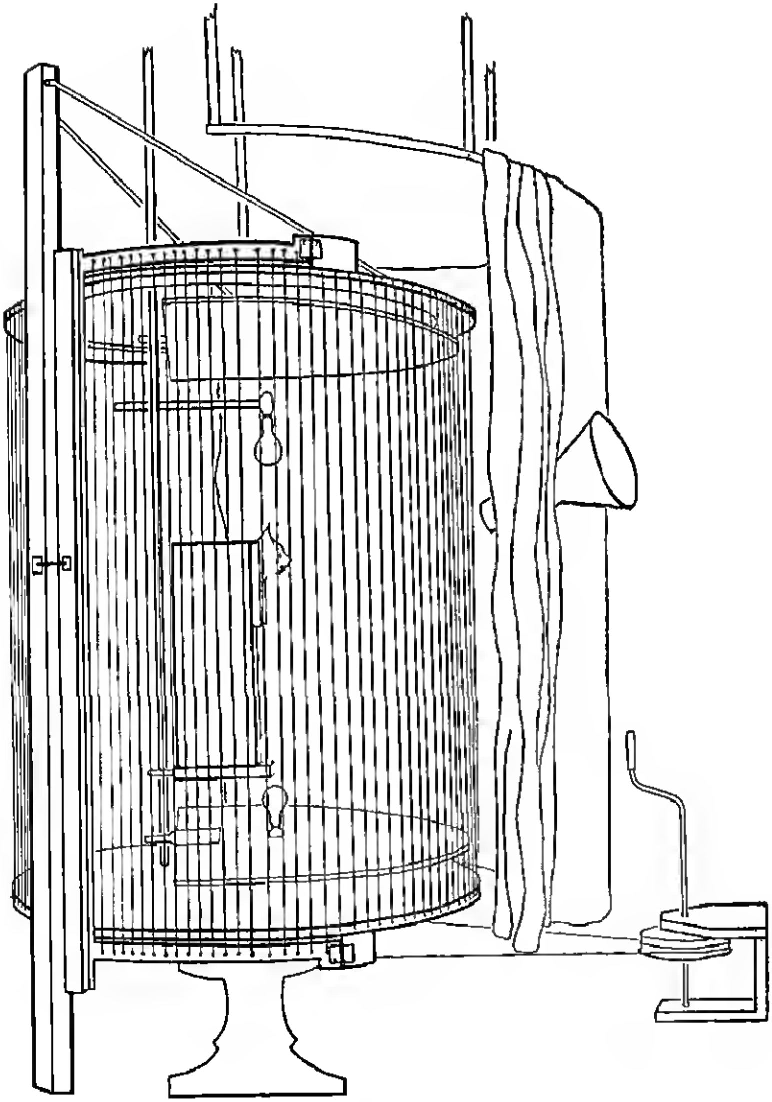

FIGURE 1

cular frame of the cylinder. The screens are made of thin composition board and are supported by clamps attached to the rod extending down inside the drum Two light sockets are placed at the axis of the cylinder, one mounted on the top surface of the lower screen and the other mounted on a rod extending out from the large support rod, above the head of the subject Two 200-watt bulbs are used to illuminate the threads which line the side of the drum

Entrance to the drum is provided by a swinging door hinged to blocks mounted on the turntable and the upper circular frame This door consists of an open frame, the two arms of which are cut so that they correspond to the arc of the cylinder Since threads may be stretched on nails driven into the arms of the door in the same way as on the rest of the cylinder, the door may be made to appear as a continuation of the rest of the drum but may be opened without interfering with the arrangement of the threads

A large semicircular iron frame, approximately 180 cm in diameter, is suspended from the ceiling of the experimental room around one side of the drum Black or white cloth draped from this frame forms a contrasting background for the threads stretched on the side of the drum A viewing tube inserted through the drape permits direct observation of the subject's eye movements which occur when the drum is rotated

The apparatus is rotated by means of a hand-driven pulley which is placed to the side of the viewing tube A larger pulley attached beneath the turntable reduces the speed approximately one-half so that the drum may be turned slowly in a uniform manner, while the experimenter observes the movements of the animal's eyes For an experimental test, the drum is rotated through 180 degrees

The animal is prepared for observation by wrapping it in about 15 feet of cheese-cloth and placing it inside the restraining box This box measures 18 cm. by 18 cm by 48 cm and has a sliding cover on one side The top of the cover and the top of the box are cut back and smoothed in order to form an aperture through which the cat's head protrudes Head movements of the animal are limited by two side-blocks mounted on the front side of the holder The head is supported at a desired height by means of a rod which is inserted in the holes drilled in these two side-blocks.

When the animal is securely restrained in the box-holder, the door on the drum is opened and the box-holder arranged on the small

platform so that the cat faces the viewing tube The drum is then moved as far as it can be rotated toward the left, and observations begun by rotating the drum through 180 degrees toward the right. This rotation through one-half the arc of a circle is counted as a single trial, during which the number of eye movements made by the animal is counted A second trial is then made by rotating the drum through 180 degrees toward the left In making visual acuity measurements, observations are begun with heavy lines, followed by increasingly finer ones The visual acuity threshold has been arbitrarily defined as the visual angle subtended by the finest threads to which the *animal responds by giving an average of* at least five nystagmic movements per trial in a series of 14 trials

2 *Animals and Operations*

Three normal animals and six animals with complete destruction of the visual projection areas of the cortex were employed in the experiment In the six operated animals, the striate areas of the cortex were removed according to a method described in previous experiments (Smith, 12) The extent of the ablation of visual cortex in four of these animals is indicated in Figure 2 These photographs show that in each of the animals all cortex lying within the first and second convolutions of the brain has been completely destroyed In addition, that striate cortex lying within the mesial gyri was removed All six animals displayed postoperatively the typical visual defects which accompany complete removal of the striate areas, and in the five brains examined histologically the external geniculate bodies displayed the generalized degeneration of ganglion cells found with complete removal of the visual areas of the cortex [1]

3 Results

Two different types of investigation were carried out In the first part of the experiment, the visual acuity of two normal and six operated cats was determined by the method described above Three normal and six operated cats were used in the second part of the experiment, which consisted in determining the maximum separation between lines of a constant width at which optic nystagmus could be elicited.

[1]The sixth operated animal is still alive at the time of writing

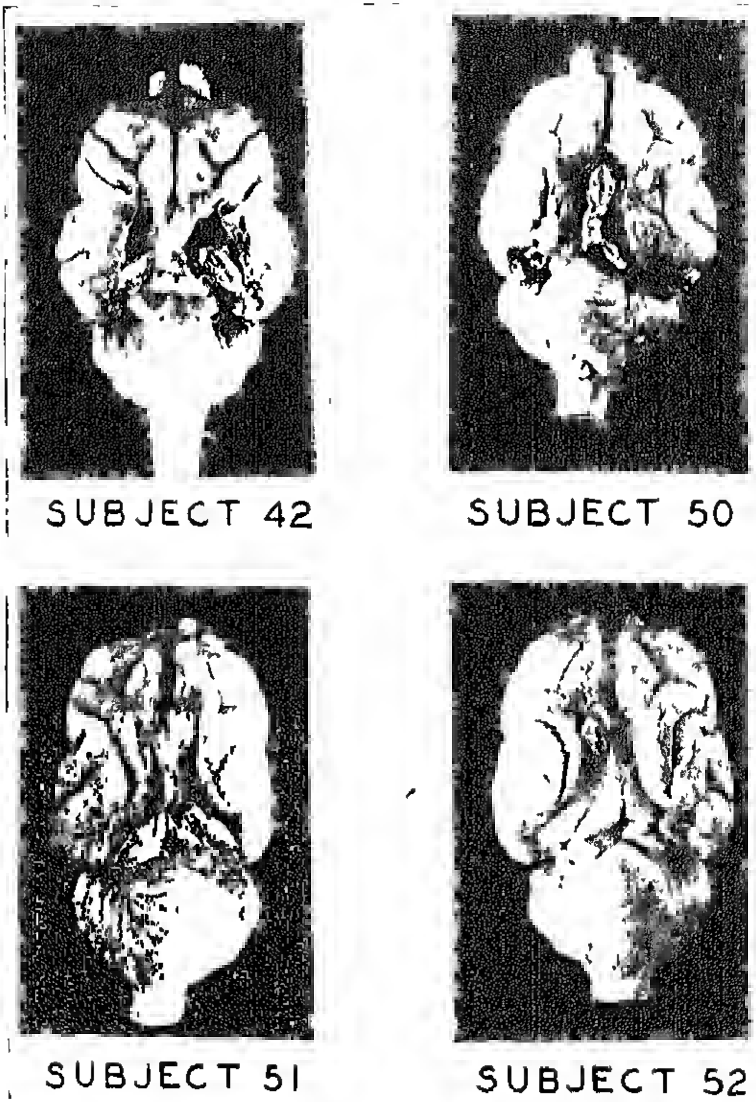

FIGURE 2

a The nature of the reactions observed during rotation of the drum Rotation of the striations lining the side of the drum produces nystagmic eye movements, which consist of the typical pursuit or fixation movements, made in the direction of the movement of the lines, and of saccadic, or ballistic, compensatory fast movements which return the eye to a more central position of fixation. Under the conditions of observation employed, even very slight reactions could be easily recognized When relatively heavy lines were employed, the reactions were particularly easy to see, for the magnitude of the movements made by the animals was large and the reactions occurred in a regular manner When the finer lines were used, however, the movements sometimes changed character, so that they appeared as slow swimming deviations of the eyes which did not have distinct saccadic movements accompanying them In all cases, only responses observed to have the saccadic phase were counted When the operated animals were being studied, head movements did not act to interfere with the observation and counting of the eye movements The head movements made by the operated animals, if they occurred at all, were optokinetic in character, i e, they consisted of deviations of the head in the direction of the moving patterns With the normal animals, however, the movement of the patterns would sometimes induce, in addition to head nystagmus, rapid irregular head movements during which the animal would fixate different positions in the cylinder but would not deviate the head in accordance with the movement of the lines. The occurrence of these irregular head movements in the normal animals made it impossible to secure reliable counts of the number of responses made with different sizes of lines

Another factor which distinguished the reactions of the operated animals was the regularity with which the nystagmic responses occurred That is, if the operated animals responded at all to a given set of lines, the response took place with clock-like regularity as long as the drum was being moved In contrast, the normal animals would sometimes respond very well to lines of sufficient size to evoke the reactions, but would stop during the middle of the trial or during the next trial would not react at all.

b The visual acuity of the operated animals. Tests of visual acuity were made by utilizing two different types of stimulus patterns, white lines moving against a black background and black lines mov-

ing against a white background. All of these lines were secured by stretching black and white silk threads of various diameters upon the drum as described previously. The white background used consisted of white bleached muslin suspended from the iron frame surrounding the drum. The black background was obtained by draping black velvet from this frame in the same manner. In Table 1

TABLE 1
THE CHARACTERISTICS OF THE LINES USED IN BOTH VISUAL ACUITY EXPERIMENTS

White lines			Black lines		
Average diameter cm	Visual angle min	Brightness ml	Average diameter cm	Visual angle min	Brightness ml
0 05	3 3	97 7	0 16	11 7	3 0
0 03	1 7	121 7	0 12	8 3	2 4
0 02	1 4	109 7	0 06	4 1	3 9
0 01	0 7	129 4	0 05	3 3	4 1
0 008	0 5	129 6	0 03	1 7	4 0
			0 01	0 7	4.2

Black background, 0 93 ml White background, 61 9 ml

are summarized the sizes of the black and white threads used in both parts of the visual acuity experiment, together with the brightness of these threads as measured by the Macbeth Illuminometer. Each brightness value represents the average of 10 readings of the Illuminometer which were secured by wrapping samples of the threads on a card in a regular manner and then measuring the brightness of the card of thread at different positions along the edge of the drum. The brightness of the backgrounds used in the two different visual acuity experiments is indicated below the table.

TABLE 2
THE AVERAGE NUMBER OF RESPONSES MADE IN FOURTEEN TRIALS TO WHITE LINES MOVING AGAINST A BLACK BACKGROUND

Subject	42	50	51	52	54	56
Visual angle						
3 3 min	12	14	12	11	13	12
1 7	9	11	14	8	10	9
1 4	8*	7	10	10*	11*	8
0 7	4	10*	9	2	1	9*
0 5	3	0	7*	3	0	2

The visual acuity data secured with the operated animals appears in Table 2. The visual angles corresponding to the different test stimuli used in obtaining thresholds are given in the column to the left, while the number of each subject appears at the top of the table. The numbers in the body of the table represent the average number of responses made by each cat during the 14 trials in which the drum was rotated in alternating directions. As indicated previously, the threshold value is considered as that angle subtended by the narrowest lines which elicited on the average at least five responses throughout consecutive revolutions of the drum. Threshold values judged according to this criterion are marked with asterisks in the table.

Reference to Table 2 will show that all of the operated cats responded consistently to white lines subtending visual angles of 1.4 minutes of arc and greater. Only three of the animals (Subjects 50, 51, and 56) gave a significant number of responses with lines narrower than this width. Subject 51 responded a fair number of times to the smallest lines used, i.e., to those subtending a visual angle of 0.5 minutes of arc.

In Table 3 are summarized similar results obtained when black

TABLE 3

THE AVERAGE NUMBER OF RESPONSES MADE IN FOURTEEN TRIALS TO BLACK LINES MOVING AGAINST A WHITE BACKGROUND

Subject	42	50	51	52	54	56
Visual angle						
11.7 min	10	8*	10*	5	11*	15*
8.3	8*	4	4	7*	4	3
4.1	0	1	1	1	1	2
3.4	0	1	0	1	0	2
1.7	0	1	1	0	1	1
0.7	1	1	1	1	0	2

lines were rotated against a white background. In this situation, the visual acuity of four of the operated animals was not better than 11.7 minutes of arc, although two of the animals (Subjects 52 and 53) responded to lines which subtended angles of 8.3 minutes of arc. There were no consistent responses to lines narrower than these values.

Although the normal animals did not react as regularly as did the operated animals to very fine lines, they did react in a significant

way to all of the situations used. That is, if the irregular occurrence of nystagmic movements be taken as significant, the normal animals demonstrated a visual acuity of at least 0.5 minutes for the white lines and 0.7 minutes for the black lines. Using the same threshold criterion as that employed with the operated animals, the visual acuity of two of the normal cats was found to be 3.3 minutes for the white lines and between 4.1 and 8.3 minutes for the black lines.

c. *The effect of increasing separation of the lines upon the reactions of the operated animals.* In the second part of the experiment, the distance between the lines was increased to determine the maximum separation at which optokinetic responses in the operated animals could be elicited. Observations were made, as in the visual acuity experiments, both with white lines rotating against a black background and with black lines rotating against a white background. The white lines employed subtended a visual angle of 7.6 minutes of arc, the black lines, a visual angle of 11.7 minutes of arc. The angular distance between the lines was increased from 2.9 degrees, that used in the visual acuity tests, to distances of 8.7 degrees, 17.4 degrees, 26.2 degrees, 35.0 degrees, and 43.7 degrees. Fourteen trials were given with each arrangement of the threads on the drum. The average number of responses made by each animal with each arrangement of the lines was determined as in the previous part of the experiment.

Table 4 summarizes the results secured with the six operated and

TABLE 4
THE AVERAGE NUMBER OF RESPONSES MADE IN FOURTEEN TRIALS TO WHITE LINES SEPARATED BY DIFFERENT DISTANCES

	Operated						Normal		
Subject	42	50	51	52	53	54	58	59	60
Angular separation									
2.9 deg	12	14	12	11	13	12	24	17	21
8.7	20	19	18	18	17	17	22	14	27
17.4	9*	5*	12	6	12*	10	16	9	10
26.2	2	1	7*	8*	4	6*	8	9	6
35.0	2	1	2	3	2	4	6	5	7
43.7							5*	5*	6*

three normal animals when the white lines were employed. The numbers in the column to the left represent the separation between

the lines and the number of each subject is given at the top of the table. Numbers in the body of the table indicate the average number of responses made by the animal in 14 trials with a given separation of the striations. Asterisks mark threshold separation of the lines, i.e., the maximum distance at which an average of at least five responses per trial could be elicited.

Reference to Table 4 will show that the operated animals responded consistently to the lines until they were separated by angular distances greater than 17.4 to 26.2 degrees. Two of these subjects still responded fairly well when the lines were separated by an angular distance of 26.2 degrees. None of the operated animals gave regular reactions with an angular separation of 35.0 degrees. Similar results on the operated cats secured with black lines moving against a white background are presented in Table 5. In this case,

TABLE 5

THE AVERAGE NUMBER OF RESPONSES MADE IN FOURTEEN TRIALS TO BLACK LINES SEPARATED BY DIFFERENT DISTANCES

Subject	42	50	51	52	53	54
Angular separation						
2.9 deg.	10	8*	10	9	11*	15
8.7	11*	1	7*	11*	0	9*
17.4	0	1	1	2	0	2
26.2	1	1	0	0	0	2

none of the animals displayed regular optic nystagmus when the lines were separated by intervals greater than 8.7 degrees.

Examination of the results presented in Tables 4 and 5 show *that there is some correlation between the frequency of responses* made by the animals and the distance between the lines on the drum. With the white lines, the frequency of the responses increased when the angular distance between the striations was increased from 2.9 degrees to 8.7 degrees. Further increase in the distance separating the lines, however, brought about a correlated reduction in the number of the responses. It is to be noted in the results presented in both of these tables that with a given separation of striations, the average responses given by the different animals agree with one another rather closely. This is true particularly when the subjects were tested at the smaller distances, but does not hold when the threshold is reached.

Normal animals tested under these conditions gave results which are both qualitatively and quantitatively different from those secured with the operated cats When the white lines were used, the three normal cats all responded consistently to the lines even when they were separated by distances as great as 43 7 degrees (Table 4) As the separation between the lines was increased, the pursuit movements of the eyes became less frequent and regular The animals still gave clear-cut saccadic eye movements as the lines were moved across the visual field, and even showed at times pursuit movements of the head, but they did not follow the movement of the lines with the eyes as clearly as when the lines were close together When black lines were used, the normal animals gave evidence of eye and head movements in response to striations separated by distances as great as 17 4 degrees The responses made in this situation by the normal animals have not been tabulated

There is a distinct difference between the ability of the operated animals to respond to white lines moving against a black background and their capacity to react to black lines rotating against a white background The maximum angular separation which elicited reactions in most of the animals in the first situation was above 26 2 degrees, while in the second situation the majority of the cats failed to react when the striations were separated by more than 8 7 degrees In addition, the frequency of the responses of the operated animals was greater when the white lines were used

When the white lines were used, the separation thresholds of the three operated cats was 26 2 degrees or above. Since the binocular visual field of cats is limited to approximately 180 degrees, not more than six or seven striations appeared in the visual field at a 26 2 degree separation of the lines Treating the data secured with the black lines in the same way, it may be said that the minimal number of lines to which most of the operated animals responded was approximately 20. Similar threshold values for normal animals in responding to the white lines are lower than for the operated animals, when the same criterion of significant response is used The three normal animals tested responded consistently when the lines were spaced at 43.7 degrees upon the drum, i e., when there were fewer than five lines appearing in the visual field at the same time Under appropriate conditions, of course, normal cats sometimes pursue with the eyes a single striation moving in the visual field.

Supplementary to these observations, the operated cats were tested in a somewhat different situation to ascertain the minimal number of alternate black and white stripes, 2.5 cm. in width, which would elicit nystagmic movements. The animals observed the lines at the same distance as was used in the experiments described above, that is, at a distance of 50 cm. It was found that at least eight to twelve such striations are needed in order to bring about clearly observable pursuit movements of the eyes in the operated cats.

C. Discussion

Inasmuch as the significance of the results depends upon the demonstration of the validity of optic nystagmus as an indicator of visual acuity, we shall consider here certain evidence that optic nystagmus is a similarly controlled function in both normal and operated cats. In a previous study (Smith and Bojar, 15) it has been shown that when optic nystagmus is recorded oscillographically in normal animals and in animals lacking the striate areas of the cortex, the major difference observable in the reactions of the animals is the greater regularity of the movements in the operated cats. The maximal velocity at which eye movements occur in cats lacking the occipital lobes of the cortex is not significantly different from similar thresholds in normal animals. In the two groups of animals, the responses vary in amplitude and frequency in the same manner as a function of the velocity of visual movement. Both normal and operated animals display after-nystagmus upon termination of the movement of the patterns across the visual field, although such after-movements may be elicited with greater frequency and ease in the operated animals. On the basis of these observations it has been concluded that the sensory processes involved in the production of optic nystagmus in normal animals and in animals with cortical lesions are sufficiently similar so that the use of optic nystagmus as a means for comparing the visual acuity of the normal and operated cats is valid.

A further indication of the validity of the method is the correspondence between the visual acuity of normal cats obtained by the rotating-drum technique, and that determined by other methods of observation. The minimum visible acuity of normal cats in responding to moving white lines in this study was 0.5 minutes of arc, as indicated by irregular nystagmic responses. In a discrimina-

tion situation, the minimum visible acuity of normal cats has been determined to be approximately 0.5 to 1.0 minute of arc (Smith, 10). Both of these values may be compared to minimum visible threshold values of 0.68 to 1.72 minutes, which were secured on five animals when they were required to leap from an elevated surface upon a moving black thread which was drawn slowly across a white surface located 50 cm. below them. Thus the rotating drum technique gives acuity measures which closely approximate those which have been secured with at least two other techniques.

Removal of the visual cortex in cats modifies but slightly minimum visible acuity as tested with the rotating-drum method. In fact, the operated cats show more regular nystagmic responses to fine striations than do normal cats. These observations confirm earlier studies in which it has been shown that minimum separable acuity is not distinctly modified by removal of the optic projection centers of the cortex (Smith, 14).

This study raises the problem of explaining the wide discrepancy between the minimum visible acuity of operated cats in responding to white lines rotating against a black surround and that secured with black lines against a white surround. Evidence has been presented which shows that a similar but slighter difference exists in the acuity of normal animals in these two situations. It is probable, therefore, that the differences found are explainable in terms of a greater physical contrast between the white lines and black background, since the average brightness ratio for the lines and the background in this situation was approximately 0.008 as compared to a ratio of 0.06 for the black lines and white background. Or it may be that a certain amount of irradiation associated with the white lines makes them intrinsically more effective in producing optic nystagmus in both normal and operated cats. At any event, it is not yet possible to state that removal of the occipital cortex in cats produces a condition in which visual acuity is affected differentially at different levels of general illumination, as has been reported previously in the case of intensity discrimination (Smith, 12).

Observations made in this study show that a major visual deficiency which results from extirpation of the striate areas of the cortex consists in an inability to respond to moving striations when they are widely separated. The threshold of separation for the operated animals used in this experiment was approximately 17.4 to

26.2 degrees of arc for white striations, 2 9 to 8.7 degrees for black striations The best of the operated animals, therefore, required as a minimum 6 or 7 white lines or 20 to 22 black lines in the visual field before they displayed optic pursuit movements to rotation of the lines Normal animals, on the other hand, respond consistently to fewer than five equally spaced white lines moving across the visual field, and can be observed at times to respond to a single line When black lines are used, consistent responses occur when 10 to 11 lines are in the visual field, and reactions occasionally may be elicited with single lines.

These observations seem to be particularly significant when it is remembered that the operated cats suffer no distinct diminution of acuity under conditions in which the moving striations are arranged in close proximity in the visual field Hence, it would seem that, rather than being concerned with visual acuity per se, the striate areas of the cortex are more intimately involved in the mediation of local differences in stimulation associated with the perception of isolated patterns in the visual field It seems clear from the results presented that optic nystagmus associated with movement of a series of closely spaced patterns on the retina is dependent upon the summation of impulses in subcortical optic centers, for the responses cannot be elicited by single lines or by widely spaced lines in the absence of the visual cortex Optic nystagmus to single lines, which is mediated cortically, obviously does not require such summation of neural activity It is of importance to note, however, that in both cortical and subcortical nystagmus, variations in the frequency of the nystagmic movements may be produced by variations in the number of lines crossing the retina in a given interval of time.

The basis of the inability of the operated cats to pursue movements of isolated patterns in the field of vision may be inferred from certain phylogenetic considerations The operated cats used in the present study behave in much the same way as normal rodents when stimulated by moving visual patterns That is, both the operated cats and normal rabbits or guinea pigs are unable to follow optically movements of isolated patterns in the field of vision, but they nevertheless display a high degree of minimum separable or minimum visible acuity for a series of closely spaced patterns [2] In normal rodents and in other animals which do not pursue optically single moving patterns there is ordinarily absent a fovea or a central area of focal vision on

[2]Unpublished observations

the retina, and conversely, animals possessing fovea or a central retinal area display pursuit movements of the eyes to movement of isolated visual patterns. It would seem probable, therefore, that the deficiencies of the operated cats in responding to widely spaced lines in the visual field are related to the functional loss of an area of focal vision brought about by extirpation of the occipital lobes of the cortex In other words, the striate areas of the cortex contain the centers necessary for focal vision but may be dispensed with in other types of pattern vision

Attempts have been made to describe defects in visual pursuit, pattern vision, and visual fixation, which are produced by extirpation of the striate areas of the cortex, in terms of defects in attention (ter Braak, 1) and object vision (Marquis, 6) The results of the present study suggest a physiological explanation for these observed post-operative defects and at the same time call for a reformulation of ter Braak's and Marquis' conclusions Specifically, the present results show that "visual attention" and object vision are not mediated exclusively by the striate areas of the cortex and are abolished in the operated animals only under special conditions of stimulation In brief, the striate areas are involved in mediating types of pattern discrimination which depend upon focal vision or which are related to isolated patterns in the visual field This conclusion stands in direct contradiction to the accepted generalization that pattern vision is completely dependent upon centers located in the striate cortex (Lashley, 3, 4, Lashley and Frank, 5, Marquis, 6) Further, the view of Poliak (9) that the cortical centers of vision in the higher mammals are the only neural levels of the optic system which are capable of mediating refined degrees of pattern vision is refuted by previous studies on minimum separable acuity (Smith, 14), as well as by the present investigation of minimum visible acuity The present experiments show that the striate areas of the cortex are involved specifically in the determination of visual acuity related to isolated patterns and are not necessarily concerned in the mediation of similar degrees of visual acuity under other conditions of stimulation The functional activity of the cortex is not qualitatively different from that of subcortical centers in the mediation of pattern vision and visual acuity, as has been held in the theories of Lashley, Marquis, and Poliak, but differs from the functional capacity of subcortical centers in a quantitative way in determining these sensory

abilities A similar previous conclusion regarding the neural basis of intensity discrimination (12) thus receives additional confirmation by the present studies of visual acuity

D. Summary

1 In the present study, the rotating-drum method has been employed to compare the visual acuity of normal cats and cats lacking the striate areas of the cortex. The minimum visible acuity of two normal cats was ascertained to be at least 0 5 minutes of arc for white lines rotating against a black background and 0 7 minutes for black lines moving against a white background These values approximate the minimum visible acuity of normal cats as determined by a discrimination method (10) and by a special jumping technique

2. Removal of the striate areas of the cortex in six cats failed to produce marked defects in minimum visible acuity When tested under the same conditions as those used with the normal cats, the visual acuity of six operated cats varied between 0.5 and 1 4 minutes for white lines and between 8 3 and 11.7 minutes for black lines.

3 A marked visual deficiency resulting from removal of the striate cortex in the cat consists in an inability to respond to striations widely separated in the field of vision. In six operated animals, the threshold separation for white lines moving against a black background was 17 4 to 26 2 degrees, while for black lines moving against a white background, the threshold separation was 2.9 to 8 7 degrees. In comparison, normal animals responded consistently when the white lines were separated by angular distances up to 43 7 degrees, and occasionally followed single lines moved before their eyes

4 It is concluded that optic pursuit movements related to single or isolated patterns in the visual field are mediated cortically, while similar responses to closely spaced patterns on the retina may be determined subcortically in the absence of the visual cortex. In the latter case, the pursuit responses to a series of adjacent striations depend upon summation of impulses in subcortical centers

5. Complete bilateral removal of the striate cortex in the cat produces limited deficiencies in pattern vision and not the abolition of all capacity to respond to visual patterns Specifically, this operation, by abolishing the mechanisms of focal vision, renders the

animal incapable of fixating and pursuing with the eyes isolated patterns moving in the visual field, although a high degree of minimum separable and minimum visible acuity, as measured by responses to closely spaced striations, may persist.

6 The disturbances in focal vision produced by complete bilateral removal of the striate cortex give a physiological explanation of the defects in visual attention and object vision which have been noted by previous observers (1, 6) in relation to experimentally produced occipital lesions in higher mammals

7. Since pattern vision may be mediated subcortically in the absence of all visual cortex as well as cortically, it is assumed that these two levels of the visual system differ quantitatively and not qualitatively in the mediation of visual functions based on pattern stimulation.

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A LONGITUDINAL STUDY OF THE OCCIPITAL ALPHA RHYTHM IN NORMAL CHILDREN FREQUENCY AND AMPLITUDE STANDARDS*

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A. INTRODUCTION

Studies by Lindsley (5, 6) and Smith (8, 9, 10, 11) have shown that in awake infants the occipital alpha rhythm usually first appears by the third or fourth month at a frequency of three to four per second Once established the frequency of the waves increases with age, rapidly during the first year but slower thereafter until a relatively stabilized adult level is attained usually sometime before the end of the twelfth year Weinbach (14) has fitted an exponential growth equation to the early data of the above investigators and has more recently (15) called attention to the fact, as has also Lindsley (6), that the growth in frequency of the waves with age follows essentially the same curve as does brain weight in children

The purpose of the present report is to show the trends of development of both frequency and amplitude of the occipital alpha waves as a function of age in a large group of normal children studied longitudinally for a period of two to three years. Because of the recent widespread clinical application of the electroencephalograph and the growing tendency to classify waves as abnormal if their frequency or amplitude is above or below a certain range, it seems desirable to present these data for possible use as standards for comparison Such standards are particularly valuable in dealing with the electroencephalograms of children since the frequency of the alpha waves varies with age and an alpha frequency abnormally low for an adult might be well within the normal range for a child

In order to compare children and adults it is necessary to present some data for the latter In a previous study (6) I reported that

*Received in the Editorial Office on July 20, 1939, for publication in The Journal of Psychology, but given immediate publication here because of the overcrowded condition of that journal

the frequency of the occipital alpha rhythm in 75 adult subjects, 52 men and 23 women ranging in age from 17 to 64 years, averaged 10.2 and ranged from 8 to 13 per second. These data are in essential agreement with other adult norms (12, 2, 7, 4), (see also 3, 1) To my knowledge the only data on mean amplitude that have been published are those by Travis and Knott (12) on 19 normal college students Using a bipolar technique (occipital to motor area) they found the amplitude for the group ranged from 12 to 31 microvolts with a mean of 19 microvolts. From some analyses now being made in this laboratory which will be published later it may be stated that the mean amplitude of occipital alpha waves (bipolar recording) for 25 college students is 13 microvolts with a range from 5 to 24 microvolts The latter data will be used for comparison since the method of recording (both electrodes over occipital region) is comparable to that used in the present study

B Technique

The apparatus and procedure have been described in detail in an earlier study (6) Briefly, two matched amplifiers and a Westinghouse type *PA* oscillograph were used to record simultaneously on photographic paper the electrical activity of the two occipital regions Bipolar recording methods were used throughout, the two electrodes of each pair of leads being separated by five centimeters The electrodes were placed just posterior to the parieto-occipital fossa in a line parallel with, but five centimeters lateral to, the mid-line. The electrodes consisted of small gold discs, eight millimeters in diameter, each sunk in a small bakelite block and attached to the head by means of bandages An electrode jelly served as the conducting medium between the scalp and the electrodes

All subjects, except the very young infants who lay on a cot, sat comfortably in a dark and relatively sound-proof room with eyes open Several short records were made at random intervals during a 15- to 30-minute period after the subject had become adapted to the experimental situation

In analyzing the records for frequency and amplitude of the alpha waves all of the readable records for each subject, consisting of a series of random samples (usually three or more meters), were used. The peak to peak amplitude of all alpha waves was measured and converted into average peak microvolts The sensitivity of the

recording system permitted adequate measurement of waves of the order of two to three microvolts. Frequency determinations were never made on a series of waves unless there were at least four rhythmic waves in a sequence.

C. Subjects

The subjects for this study were 132 normal, white children ranging in age from one month to sixteen years. Of this group, 76 were boys and 56 were girls. Most of these children were members of a much larger group whose growth and development was being studied regularly by the staff of the Associated Foundations of Western Reserve University under the direction of the late Professor T. Wingate Todd. Only children of good health were included in the program and the group was admittedly a "selected" one inasmuch as the majority of the children came from homes well above the average, culturally and economically.

Whenever possible, brain potentials were recorded from each child when he came for his regular serial examination, every three months (dating from birth) for the first year, semi-yearly from one to five years of age and yearly (within one week of the birthday) thereafter. In all but 11 of the 132 subjects two or more serial brain potential examinations were made, and in 42 three or more examinations were made during a period of two to three years. In the case of some infants records were obtained at monthly intervals.

D. Results

In 12 infants an occipital alpha rhythm was present at three months of age. During the next few months the frequency and amplitude of the alpha waves increased and the rhythm became more persistent. As may be seen in Table 1, which shows the average, median, and range of frequency and amplitude for each age level, the average frequency at the onset of the rhythm at three months was 3.9 per second (range 3.3 to 4.7) and the average amplitude was 37 microvolts (range 10 to 48). By the end of the first year the average frequency had increased to 6.3 per second and the average amplitude to 52 microvolts. This represents more than a 60 per cent increase in frequency and more than a 40 per cent increase in amplitude during the first year. During the succeeding years the frequency continued to increase but by smaller and smaller annual

TABLE 1

GROUPED DATA SHOWING AVERAGE, MEDIAN, AND RANGE OF FREQUENCY AND AMPLITUDE OF THE OCCIPITAL ALPHA WAVES

Age	Frequency per second				Amplitude in microvolts			
	No	Av	Med	Range	No.	Av	Med.	Range
3 months	12	3.9	4.0	3.3- 4.7	9	37	38	10-48
6 months	10	4.5	4.5	4.0- 4.8	6	42	41	28-60
9 months	10	5.8	5.9	5.3- 6.3	10	50	52	26-68
12 months	9	6.3	6.5	5.5- 7.0	8	52	48	34-84
18 months	11	6.8	6.8	5.3- 7.4	9	43	42	22-62
2 years	17	7.0	6.8	5.0- 9.6	13	49	51	24-68
2½ years	9	7.1	7.2	6.3- 7.7	8	45	44	28-62
3 years	8	7.5	7.5	4.3- 8.5	5	51	54	38-60
3½ years	12	8.0	7.6	6.5- 9.6	10	32	33	16-46
4 years	10	7.7	7.8	6.0- 9.2	9	27	24	19-40
4½ years	10	7.9	7.9	7.3- 8.8	8	29	27	16-52
5 years	15	8.4	8.5	7.3- 9.4	16	31	30	12-74
6 years	20	8.6	8.5	7.3-10.3	14	27	28	16-42
7 years	20	9.0	9.3	7.9-10.0	17	25	22	12-44
8 years	15	9.3	9.2	7.3-10.3	12	21	20	14-36
9 years	18	9.3	9.4	8.4-11.4	15	21	22	10-34
10 years	22	9.4	9.3	8.0-11.6	18	19	16	10-34
11 years	31	9.8	9.9	8.0-12.0	21	20	16	10-44
12 years	31	10.2	10.3	8.0-12.0	27	20	20	10-42
13 years	36	10.3	10.2	8.0-12.1	28	19	16	8-36
14 years	22	10.3	10.3	8.7-12.2	19	18	17	7-34
15 years	13	10.3	10.5	8.9-12.6	9	14	14	6-22
16 years	8	9.9	10.0	9.0-11.0	3	13	12	10-16
	369				294			
Adults	75	10.2	10.3	8.0-13.0	25	13	13	5-24

increments until the average for adults (10.2 per second) was first attained as an average at 12 years of age. The amplitude on the other hand did not increase above the average at one year of age, but remained about the same until three years of age. Between three and four years of age the amplitude dropped sharply (see Figure 3) from an average above 50 microvolts at three years to below 30 microvolts at four years. From four years on the amplitude decreased very gradually until the adult average (13 microvolts) was reached at about 15 to 16 years of age.

The data for all subjects included in Table 1 are plotted in Figures 1 and 2. The measurements at successive examinations are connected by lines to show the trend of frequency and amplitude changes as a function of age for individual subjects and to show the distributions for the group as a whole. The curves of average

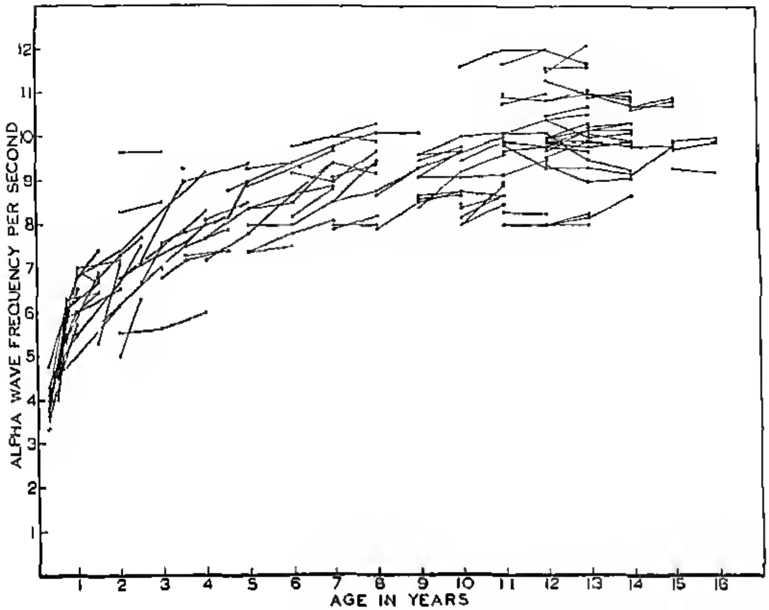

FIGURE 1

INDIVIDUAL CURVES OF OCCIPITAL ALPHA FREQUENCIES REPRESENTING 369 SEPARATE EXAMINATIONS ON 132 DIFFERENT SUBJECTS

frequency (heavy solid line) and average amplitude (heavy dotted line) are plotted in Figure 3. Also shown in this figure are some curves of frequency and amplitude (thinner solid and dotted lines) *for individual subjects representative of various age levels*. These will be seen to follow the same trend as the curves of average frequency and amplitude for the groups. Further evidence that the serial or longitudinal measurements on individuals correspond essentially with the cross-sectional data for the group is shown in Table 2 where the successive and amplitude measurements for the 42 children studied three or more times during a period of three years are given.

1. *Frequency*

To return to the changes in frequency of the occipital alpha rhythm as a function of age, let us turn again to Table 1 and Figures 1 and 3

TABLE 2

Serial Data Showing Frequency per Second (Above) and Amplitude in Microvolts (Below) of the Occipital Alpha Waves

Subj	Sex	3	6	9	12	18	24	30	36	42	48	54	60	72	84
1	M	(4 9)	4 5	6 3	6 5	(6 9)	(7 0)	(7 0)	7 3						
		(64)	60	62	57	(51)	(51)	(44)	32						
2	M	4 7			6 8	7 4									
		36			38	30									
3	M	3 7			6 9	6 7									
		36			34	38									
4	F	4 0	4 6		7 0		7 2								
		10	28		38		66								
5	M	4 0		5 4	6 0	6 5									
		58		64	84	62									
6	F	4 0	4 0	5 4		6 9									
		—	—	50		36									
7	F	4 3	4 8	6 1		6 7									
		12	38	36		22									
8	M	3 5	4 5				6 2								
		36	44				68								
9	M		4 1	5 9			6 6								
			36	54			60								
10	M		4 7		5 5		6 7	7 5							
			46		38		54	40							

TABLE 2 (*continued*)

Age in months		3	6	9	12	18	24	30	36	42	48	54	60	72	84
11	M					6.8 58	7 3 48	7 7 48							
12	M						6 8 60	7 1 48		7 6 46	8 0 40				
13	F						5 5 56		5 6 44		6 0 36				
14	M							6 7 44	6 7 —		6 5 24	8 3 30			
15	F								4 3 60	4 5 —			7 3 74		
16	M								7 6 54	7 8 —		8 2 34	9 0 32		
17	M										7 7 22		8 3 20	8 7 24	
18	M											8 8 48	9 0 —	8 4 —	
19	M												8 0 36	8 0 42	8 5 44
20	F												8 5 14	8 5 16	9 4 22
21	M												7 4 40	7 8 28	8 1 30

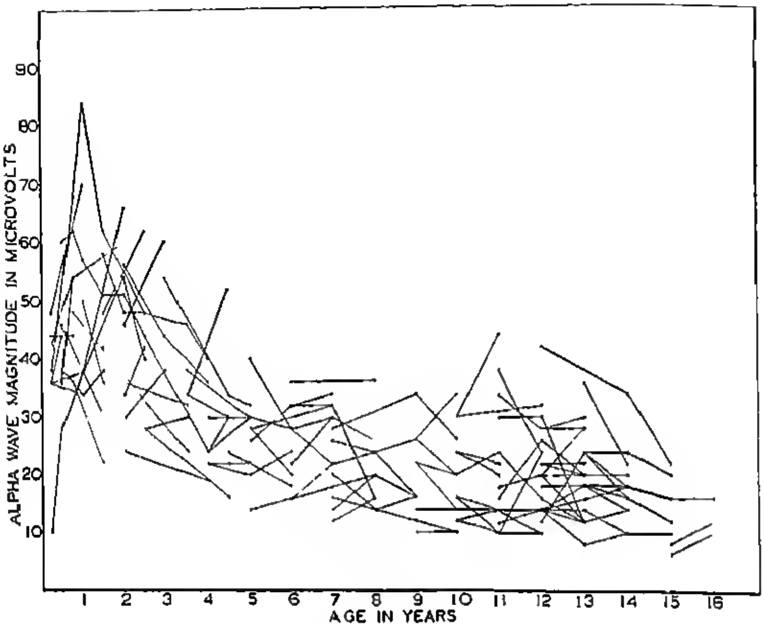

FIGURE 2

INDIVIDUAL CURVES OF OCCIPITAL ALPHA AMPLITUDES REPRESENTING 294 SEPARATE EXAMINATIONS ON 132 DIFFERENT SUBJECTS

Although the average for adults (10.2 per second) is first attained as an average by the children comprising the twelve-year-old group, one notes that the lower limit (8.0 per second) of the adult range of frequencies is first exceeded by the average of the group at five years of age. The median at this age indicates that 50 per cent of the children at five years of age have alpha frequencies exceeding the lower limit of the adult range. Except for one perhaps spurious case with a frequency of 9.6 per second at two and again at 3.5 years of age (see Figure 1) the lower limit of the adult range is first exceeded by a few subjects at three years of age. Thus, although one can be fairly sure that if the frequency of a child's alpha rhythm is below eight per second it will increase further, it is difficult to predict how much it will go beyond eight per second. From the data in Table 1 it appears that the average, median, and essential

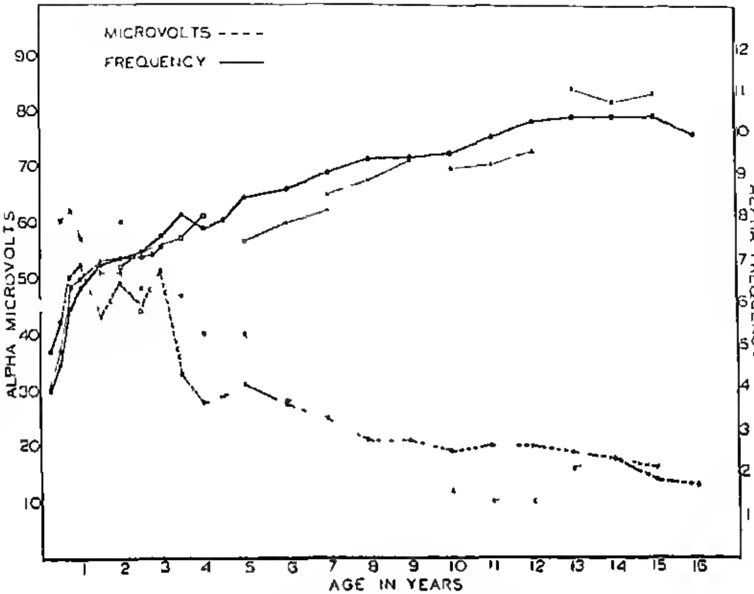

FIGURE 3

CURVES OF MEAN FREQUENCY (HEAVY SOLID LINE) AND MEAN AMPLITUDE (HEAVY DOTTED LINE) FOR ALL SUBJECTS

The thin lines (solid and dotted marked by symbols) are curves of frequency and amplitude for individual subjects studied three or more times

range of the adult is first reached by the 12-year-old group. A glance at Figure 1 reveals also that most of the individual curves of frequency have flattened out and show relatively little rise beyond the age of 12.

Observation of Figure 1 where serial frequency measurements for individual subjects are plotted shows that the frequencies for most age levels are fairly well distributed. The range of frequencies is relatively narrow during the first year, despite the fact that the largest increments in frequency occur during this period. After one year of age the range increases, but except for an occasional subject it does not exceed 2.5 cycles per second until 10 years of age, thereafter the range is almost equal to that of the adult group. At ages two, three, and four (see Figure 1), the frequency measurements

for three children deviate considerably from the rest of the group Although there were no obvious abnormalities it is perhaps significant to note in connection with these frequency deviations that all three children were rated as somewhat emotionally unstable, i.e., their behavior at home and in the research examinations was characterized by excessive timidity, flightiness, distractableness, temper tantrums, and other indications of poor adjustment The child with the lowest frequencies at two, three, and four years of age was also one year below the weight standards for her age at three years and had an essentially borderline mental classification (*IQ* 81) One can only speculate as to whether the frequency deviations, probably associated in some way with variations in brain growth and development, are also associated with the behavior characteristics of these children. It would have been interesting to follow them farther and learn whether with increasing age the frequency would approach the range of the group or continue to deviate from it

2 *Amplitude*

One notes on looking over the individual data in Table 2 and in Figure 2 that during the first year, while the occipital alpha rhythm is becoming better established, the amplitude in some of the infants increases and reaches a maximum between the end of the first and second years In others it seems to have its full magnitude when first observed at three or four months of age and begins to decrease almost immediately The individual curves of amplitude (Figure 2) show that the general trend is downward after one year of age. This is shown also in Figure 3, but here the curve of average amplitude for the group shows a marked decline in amplitude between three and four years of age After four years of age the decline is more gradual and the average adult level is reached by the average of the group at 15 to 16 years of age

In Figure 2 it will be noted that after four years of age only two subjects show amplitude measurements above 40 microvolts It will also be noted that most of the individual curves represented here show a downward trend after four years of age.

3. *Relationship between Frequency and Amplitude*

From the individual curves of frequency and amplitude shown in Figures 1 and 2 and from the curves of the averages of frequency

and amplitude for all subjects in Figure 3 it appears that there is essentially an inverse relationship between frequency and amplitude. If this were true it would agree with the results of a study by Travis and Knott (13) which showed a low positive relationship ($r = 0.40$) between the amplitude and duration (the reciprocal of frequency) of 10 alpha waves taken at random from the records of 19 subjects Actually in the present study, however, the relationship does not seem to be a direct one, for when correlations were made between frequency and amplitude with age held constant (i e, at any one age level) no significant relationships were found For example the rank difference correlations between frequency and amplitude at age seven and eleven were respectively, 0 20 and 0.01 Thus, although frequency and amplitude of the occipital alpha waves vary inversely as a function of age (frequency increasing and amplitude decreasing) there appears to be no direct relationship between the two, the variations of both are probably due to independent factors The possible nature of these factors will be discussed later

4 *Longitudinal Records*

To illustrate the manner in which the occipital alpha rhythm develops and changes in frequency and amplitude with increasing age during the early years samples of the records from a child studied 16 times during the first three years of life are presented in Figure 4. These are tracings of the actual records equated for time and magnitude Records were made regularly each month for the first year of life and at irregular intervals thereafter until three years of age.

Although beta waves and occasionally other doubtful rhythms (mainly random waves) of low amplitude appeared earlier, the first persistent alpha rhythm began at four months of age as may be seen in Figure 4 The average frequency of the waves at onset of the rhythm was 4 0 per second and the average amplitude 64 microvolts Thereafter the frequency increased, reaching an average of 7 3 per second at three years of age, and the amplitude decreased to 32 microvolts The serial frequency and amplitude data for this child (subject No 1) are given in Table 2 The values in parentheses have been placed under the nearest age classification in the table, the actual age for each of these examinations is given opposite the records in Figure 4 The data for this child are plotted in Figure 3

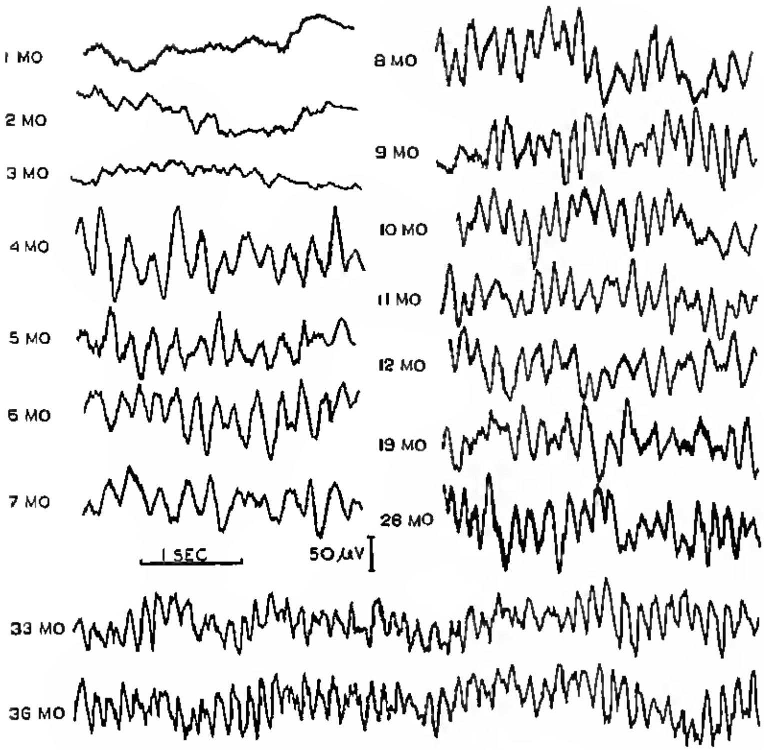

FIGURE 4

Paniograph Tracings (Equated for Time and Magnitude) of the Occipital Brain Potential Records from a Child Studied Serially During the First Three Years of Life, Showing the Onset of the Occipital Alpha Rhythm at Four Months (Frequency 4.0 per Second, Amplitude 64 Microvolts) and Its Subsequent Development to Three Years of Age (Frequency 7.3 per Second, Amplitude 32 Microvolts)

as the individual curves marked by open triangles. This represents one of the cases in which the amplitude was at a maximum when the alpha rhythm was first observed; after nine months of age it decreased consistently. Frequency increased almost exactly according to the average for the group up to the age of three years. The

pattern of the activity remained essentially the same throughout with the alpha waves present practically 100 per cent of the time

E Discussion

Both the longitudinal and the grouped data presented here confirm the earlier cross-sectional findings of Lindsley (5, 6) and Smith (8) on the increase in frequency of the occipital alpha waves as a function of age They are also in close agreement with the results of the more intensive serial studies of Smith (9, 10) on very young children.

The onset of the occipital alpha rhythm sometime around the third to fourth month in infants is undoubtedly associated with the development of certain functional capacities of the visual area The increase in frequency of the waves with age is probably associated with some aspect of growth and development of the brain since the data on brain growth in children assembled from different sources by Weinbach (15) and Lindsley (6) were found to follow similar developmental trends

Changes in amplitude of the alpha waves with increasing age may in some way be related also to growth and reorganization of patterns of activity in the brain, but the changes in amplitude with age observed in this study, since they bear no direct relationship to the changing frequency, might be interpreted in another way. Travis and Knott (13) interpreted the relatively low positive relationship they found between amplitude and duration of alpha waves as evidence of a common factor underlying variations in frequency and amplitude They assumed that the underlying factor was the number of neurones forming an active gradient, thus, the greater the number of cells active, the greater the magnitude and duration of the resulting potential wave

The increase in the amplitude of the alpha waves found in some but not all subjects during the first year or two may well be due to the activity of more and more functional units, but the low resistance pathway afforded by the unclosed fontanelles probably accounts for the high amplitude of the alpha waves during the first three years The usual age for the closing of the anterior fontanelle (the end of the second year) coincides fairly closely with the sharp drop in the magnitude of the alpha wave which occurs during the third year The fact that this drop is so sharp and is unaccompanied by any corresponding change in the frequency of the waves suggests that

its cause is extrinsic to the brain itself. It is perhaps not unreasonable to look upon the continued gradual drop in amplitude after four years of age as due in part to increased resistance offered by an increased thickness of the scalp and skull during the succeeding years. If these factors do operate in this way to cause an apparent decrease in amplitude it is obvious that any direct relationship which might obtain between amplitude and frequency as functions of brain growth and development would probably be over-shadowed.

F. Summary

A study of the frequency and amplitude of the occipital alpha rhythm in 132 children ranging in age from one month to sixteen years of age has been made, and the data grouped for use as standards. Frequency measurements are based on 369 and amplitude on 294 separate examinations at the various age levels. Serial or longitudinal observations were made on most subjects and show that the changes in frequency and amplitude with increasing age for individuals confirm those established for the group, cross-sectionally. The alpha rhythm once established increases rapidly in frequency during the first year but more slowly thereafter until the adult average is first reached as an average by the 12-year-old group. Amplitude of the alpha waves increases during the first year or two but drops sharply during the third year and more gradually thereafter until the adult average is reached at about 15 to 16 years of age. The changes in frequency and amplitude of the alpha waves as a function of age are not directly related.

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SHORT ARTICLES AND NOTES

The Journal of Genetic Psychology, 1939, 55, 215-220

"BODY JERK" AS A CONCEPT IN DESCRIBING INFANT BEHAVIOR*

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Anyone familiar with the literature on infant behavior knows the confusing welter of terms used to describe those responses characterized by the suddenness and jerkiness of the movements involved. Such terms as "surprise," "startle," "arm startle," "fear reaction," "*Umklammerungsreflex*," "spasmodic start," "fright," "body jerk," "jump," etc , are all used with reference to this type of behavior. The confusion has recently been reviewed by Wagner (11) Her survey of the literature plus some experimental observations of her own lead her to conclude that it is only by a very loose definition of these terms that we can find an appreciable number of examples of each, since the "jerky" or "starting" behavior of the infant covers a multitude of variable responses without any great regularity and uniformity, and that we had best confine ourselves to the single term, "body jerk" This she proposes as a generic term to cover all infant behavior typified by a sudden jerk or tensing of the trunk, plus limb movement This conclusion, however, is contrary to the experimental findings in the field, and can be reached only by the neglect of certain investigations

A more careful survey of the literature would show that the confusion was more typical of the early work, and that the gradual application of adequate analytic techniques has resulted in the discovery and naming of two definite patterns of "jerky" or "sudden" behavior in the infant To overlook these as Miss Wagner has done, and to return to the original undifferentiated chaos by sug-

*Received in the Editorial Office on September 2, 1938

gesting a single term *"body jerk,"* to cover all instances of "starting" behavior in the baby is to invite further confusion and to negate the increasing clarification that experimental progress has brought.

The first of the definite, patterned responses of the sudden type is the Moro reflex or *"Umklammerungsreflex"* reported by Moro in 1918 (8). In this response the arms are extended out at the sides at right angles to the body, usually with a slight curvature so that they arch forward. The fingers may be extended and spread apart, although this is neither always present nor complete. Sometimes a fine tremor appears in the extended arms. Accompanying the arm movement there is an extension of the trunk and extension of the head backward. The legs are brought up and outward at the hip and knees are flexed. The result is a mild bowing effect. In the very young infant the extended arms are then brought slowly forward and inward over one another. This gives a fallacious impression of clasping from which the name *"Umklammerungsreflex"* has been derived. In older infants this clasping behavior disappears and the extended arms drop down to the sides (3). The most definite and impressive element of the pattern is the extension of the arms. The most commonly used stimulus in eliciting this response is a sudden blow on the bed or table supporting the infant. It has also been elicited by sudden loud sounds, tapping the abdomen, extending the legs at the hips, blowing on the face, cold or warm applications on the trunk, and a sudden movement through space. The response is definite, easily recognized, and quite common in very young infants, although it begins to deteriorate after the first month and is seldom seen after the fourth month of life. This reflex is mentioned frequently in both the medical and psychological literature. McGraw has recently made a study of its developmental aspects (7), and Goldstein has proposed it as an indicator of the immaturity of the higher nerve centers (2).

The second definite response of a sudden nature is the startle pattern. This was first reported as a distinct pattern of behavior in 1929 by Strauss, who clearly differentiated it from the Moro reflex (10). It has since been studied extensively in infants by Hunt, Clarke, and Hunt (4). The startle pattern is typified by flexion. The eyes blink, head moves forward, and the shoulders come up and in. There is abduction of the upper arms, flexion at the

elbows, pronation of the lower arms, and flexion of the fingers The trunk flexes, the abdomen contracts, and there is mild abduction of the legs with flexion at the hips and knees There usually is some plantar response, but this is not regular in form (1) The leg movements resemble those in the Moro reflex, but the two patterns can be differentiated clearly in the upper limbs (6) The startle pattern is elicited primarily by sudden loud sounds, but has been found in response to other stimuli of a sudden, intense nature (5) It is not always found in complete form, and minor irregularities may occur It appears in the infant's behavior sometime during the first six weeks For a time it appears to overlap with the Moro reflex, since ultra-rapid photography may show the appearance of both response (the startle pattern coming first) following one and the same stimulus, but, whereas the Moro reflex disappears, the startle pattern remains throughout life Figure 1 illustrates both these patterns and shows their differences

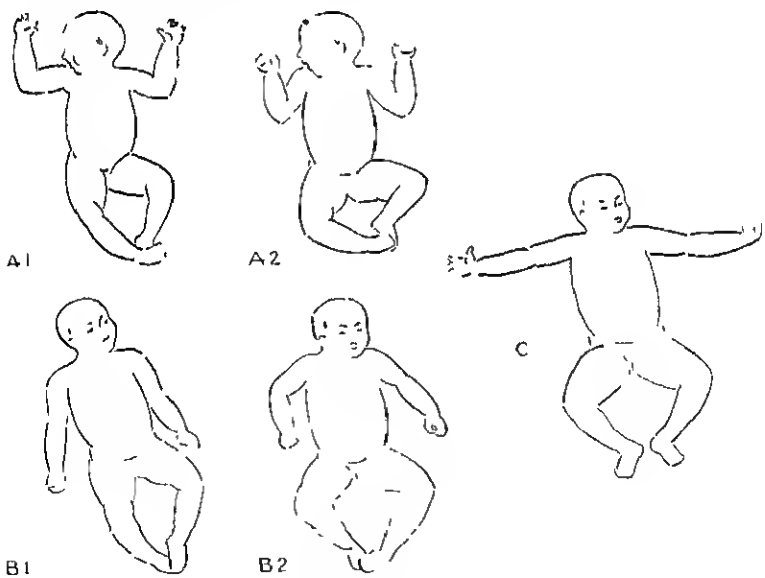

FIGURE 1

A_1 and B_1 = normal resting posture
A_2 and B_2 = startle pattern
C = Moro reflex

The existence of these two responses indicates that the "jerky" behavior of the infant is not as chaotic as Wagner would claim. It is true that in addition to these two responses there is much movement of a sudden sort which is random in nature and unclassifiable, but there is no need to coin a specific term for it. It can be treated as random movement and described specifically, i. e., "a sudden flexion of the left arm." To gather this random behavior together with the Moro reflex and the startle pattern under the single term, "body jerk," unnecessarily dignifies the random movement and increases that very confusion that Wagner is attempting to avoid. When and if further definite uniformities of response are isolated, and there is every probability that they will be found, new terms can be coined. Meanwhile the present terminology appears adequate.

In support of her negative conclusions Wagner has quoted data obtained by her in a study on the depth of sleep in newborn infants (12). The reinterpretation of "cold" data obtained previously, and its application to a new problem is never ideal. Such data is usually gathered under conditions and methods suited to the first problem, but not suited to the second one. This seems particularly true in this case.

In her original study Wagner observed the responses of some 197 infants to over 5,000 various stimulus situations (12). The reactions were observed directly by eye and recorded in writing on a moving tape as they occurred. As she admits, this gave the observer a lot to do. The completeness of the observations must have suffered. Moreover, it is doubtful whether mere unaided observation by eye can ever give accurate data upon the nature of rapid, complex bodily movements. In our work upon the startle pattern we have found such observations to be highly unreliable. As Miss Wagner herself points out, "There were occasional variations in the description of a specific behavior item such as 'quick jerk of legs' versus 'strong flexion of legs,' but such variations could in no way affect the results in the light of the method of treating the data." Such differences may not have been important for her original study, but their importance for the later study is evident. Only cinematographic records, which duplicate the complete behavior and can be observed over and over again under different sets of attention and by different observers, give an adequate rendering of complex responses, and even here it is frequently necessary to use a slow-motion

technique to reveal the true behavior Under the circumstances, it is doubtful whether Miss Wagner could have observed accurately total behavior patterns involving many elements, even if she had been "set" for them, as she was not There is no indication that she was watching for either the Moro reflex or the startle pattern as such, indeed, the conditions of the experiment set her observations *in the opposite direction toward the analysis of elements rather* than the recognition of total patterns In order to avoid the impossible task of a complete description of the behavior, she was recording in terms of the activity symbols used by Pratt, Nelson, and Sun (9) These are unfortunately analytical in nature and preclude the adequate recording of patterned responses. In short, Wagner found chaos in the sudden movements of her infants because that was all she was equipped to notice

In conclusion, we must reject Wagner's proposal to classify all the "quick" or "jerky" behavior of the infant as "body jerk," on the grounds that it conceals definite patterns which exist in such behavior, and unnecessarily dignifies the remaining random movements Two responses of the sudden sort have already been isolated, *described, and adequately named The remaining random* behavior needs no special designation. For the future we may suggest that in dealing with the sudden behavior of the infant (*a*) The Moro reflex be called the Moro reflex, (*b*) the startle pattern be called the startle pattern, (*c*) no further terminology be introduced until careful observation shows the presence of those regularities and uniformities of response whose discovery properly precedes the introduction of terminology

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APPARATUS

The Journal of Genetic Psychology, 1939, 55, 221-228

A STYLUS PUNCH BOARD MAZE WITH AUTOMATIC DIFFERENTIAL AND CUMULATIVE RESPONSE INDICATORS*[1]

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The apparatus herein described was planned with reference to the following specifications. (*a*) Flexible pattern-settings, permitting quick change of patterns for successive learning experiments; (*b*) provision of differential signals or punishment factors, for four multiple choice elements at each choice point, (*c*) automatic recording of the response sequence at each choice point, (*d*) automatic recording of motor over-reaction; (*e*) for the subject's information, provision of a visual record of cumulative total errors. The signal control and cumulative error indicator are not limited to use with this particular maze They may be used in many experiments where a cumulative error indicator is desirable and where differential signals are required.

The apparatus consists of the three units, *A*, *B*, and *C* in Figure 1. Unit (*A*) is the stylus punch maze, (*B*) the control switch board which sets up the maze patterns, and (*C*) the cumulative error indicator unit which contains the relays, timers, and automatic control devices

The maze unit, *A*, is 13 inches long by 8 inches high, by 7 inches wide The stylus holes, of which there are eight rows of four each, are ⅛ inch in diameter. Each hole in a given row is one inch

*Accepted for publication by Harold F. Jones of the Editorial Board, and received in the Editorial Office on September 5, 1938

[1]The specifications of this apparatus were prepared by Dr Harold E Jones, Director of the Institute of Child Welfare of the University of California The maze has been used under his direction as a part of a longitudinal study of children during adolescence

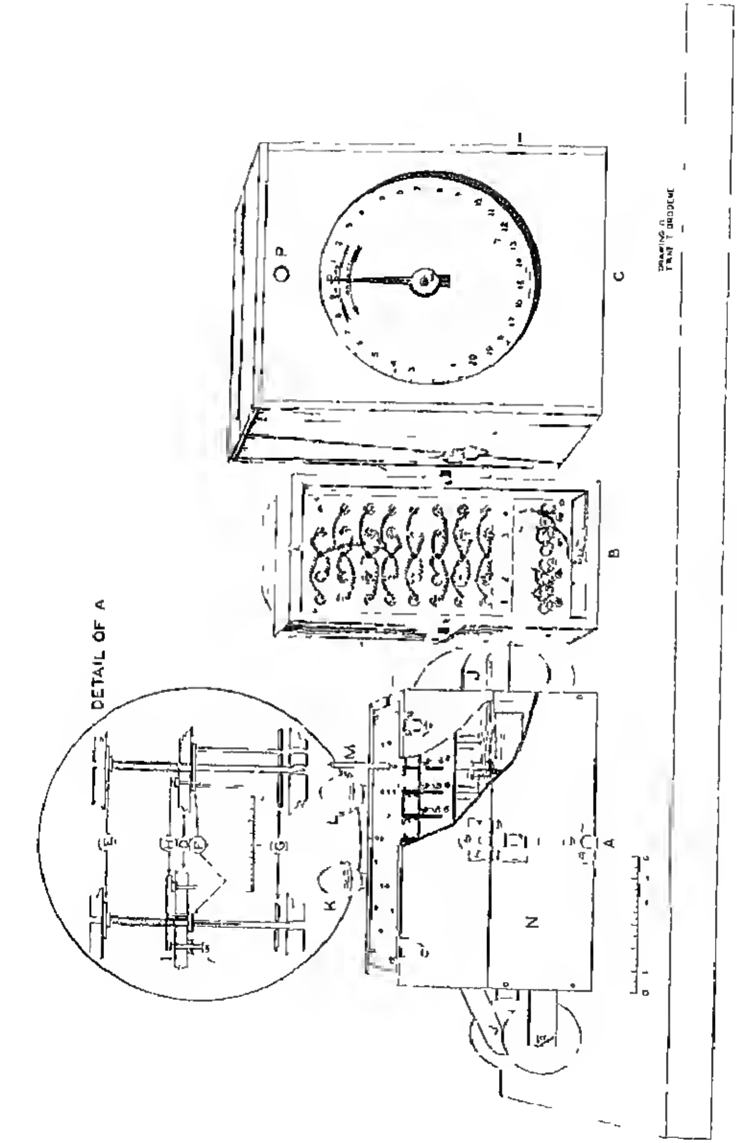

FIGURE 1

from its neighbor. Adjacent rows are separated $1\frac{1}{4}$ inches. Attached to brackets at the side away from the reader are two lamps with red and green lamp covers (K and L); the red lamp is used as an error signal, the green lamp as a "correct response" signal. The maze unit consists actually of two boxes hinged at the back. The upper section has three bakelite partitions, the top one being the face of the maze containing the stylus holes. The middle partition which is indicated in the cut away and also at (D) in the detail contains the electric contacts for each stylus hole, and serves as a bearing plate for the plungers and expansion springs (see detail). The cut away portion of Unit (A) in Figure 1 shows one of the plungers partially depressed by the insertion of the stylus (M). It may be observed that the stylus point presses against a round plate (E in the detail) attached to the upper end of the plunger, and that the plunger is depressed against the resistance of a compression spring. All spring pressures are equated so that equal pressure is required to depress each plunger. When the plungers are not depressed the round plates which take the point of the stylus (E in the detail) rest flat against the under side of the upper maze partition and cover each stylus hole. The diameter of these plates is such that the entry of the stylus at its widest possible angle will not fail to contact the plate surface. Between the middle partition and the lower partition are spikes attached to the plungers and used for providing a response record. Each plunger has a cross bar (F in the detail) into which are screwed three pointed metal spikes of different diameters and lengths. The middle spike, which is the longest and largest in diameter is the shank of the plunger itself, which normally extends to within $^1/_{16}$ of an inch of the lower side of the bottom partition. Slightly raised above the top of this bottom partition is a metal grid (G in the detail) containing precisely spaced holes into which the two longer spikes are always inserted. This serves to keep all the plungers oriented with respect to the appropriate holes in the bottom bakelite partition. The plunger cross bars, which hold the spikes, normally push up against a vertical extension of the spring wire (H) which extends through the middle partition and is part of the electric contact device. When the plunger is depressed, the pressure on the spring wire (H) is released and electric contact is made through two silver electrodes (at I in the detail).

Considering now the hinged lower half of the maze unit (N),

the principal feature of this is a bakelite top with holes which correspond in position to the spikes of the plungers. The two halves of the maze are kept in precise alignment by means of dowels let into the frame.

A roll of adding machine paper four inches wide (J) is attached to the lower box, the free end of the paper passing between the two boxes. When a plunger is depressed by the insertion of the stylus through one of the holes in the top plate, the paper is pierced by the sharp tip of the long middle spike. A movement of about $^1/_{32}$ of an inch is sufficient to pierce the paper. At the same time that the longest spike pierces the paper the electric contacts are closed. One-quarter of an inch further depression results in the next longest spike piercing the paper; if the plunger is depressed one-half inch more the shortest and last spike punches a hole in its appropriate position in the recording tape. The plunger may be depressed a total of one inch against the pressure of the compression springs. At the end of each trial the paper is pulled forward between the two boxes. It is thus possible to obtain, in the perforated tape, a complete record of errors together with three possible degrees of pressure registration. It should be pointed out that the minimal degree of pressure needed to puncture the paper with the largest spike is adequate also to operate the various electrical circuits providing signals of success and failure etc., greater degrees of pressure are indicative of motor over-reaction.

The control unit (B) is connected to the maze and the indicator unit by flexible plug-in cables. This control switch board is equipped with *GR* plugs and jacks. Each jack corresponds to one of the stylus holes of the maze and each *row* of four jacks has a set of four plugs. These plugs are differentiated by one, two, three, or four encircling identification bands which correspond to the four relay circuits controlling various signals and recorders. The eight plugs at the bottom of the panel are the outlets for the four types of plugs in each row above and allow the experimenter to plug in any one of the four types of connections to a particular stylus hole and relay circuit, or to form combinations of relay circuits.

The indicator unit (C) has on its face a dial (9½ inches in diameter) the circumference of which is divided into 30 error markings. A small signal lamp (P) is placed over the dial. The indicator hand is held to the shaft by a friction spring so that it may

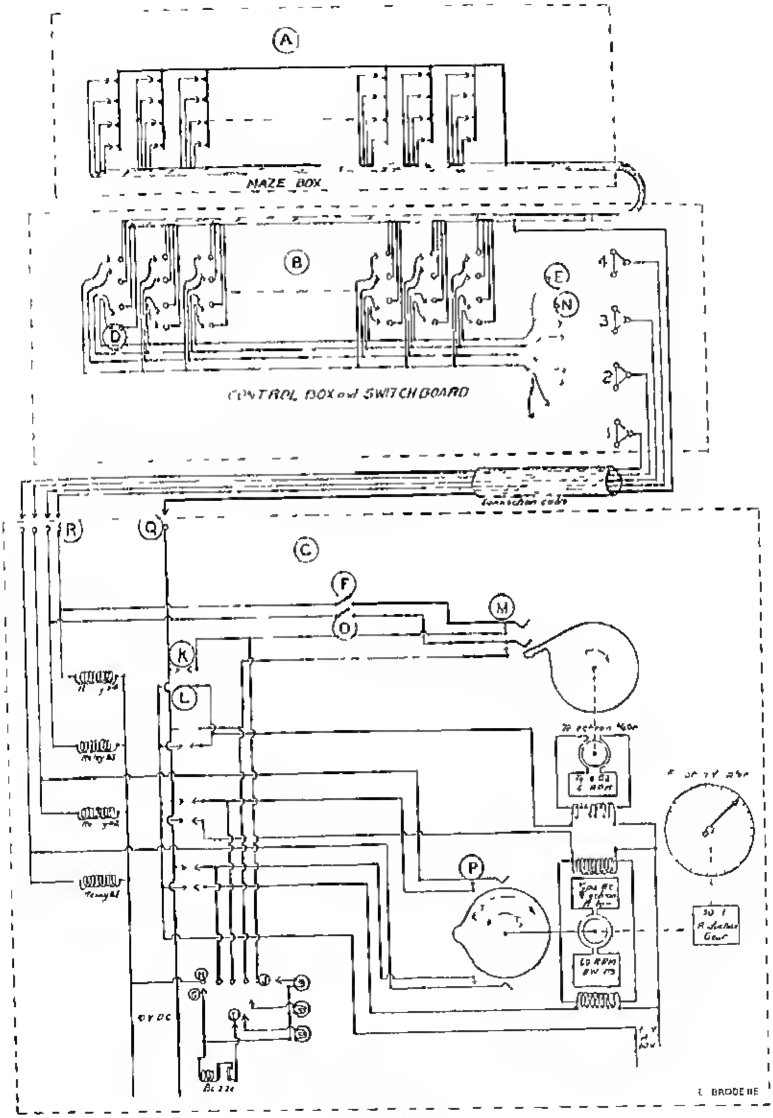

FIGURE 2

be reset without turning the shaft. The back of the unit has a 110-volt input socket, low voltage binding posts and a multiple jack to connect the cable from the switch board unit In practice all low voltage direct current is supplied by a small step down transformer and full wave oxide rectifier which fits inside the box The absence of batteries reduces the weight and eliminates the annoyance of run down batteries as well as adding to the portability of the apparatus.

The control box (B) has its switching panel set into the box a sufficient amount to provide for storage of the connecting cables. When it is necessary to transport the maze this unit fastens to the lower side of the maze unit and a lid containing a handle is fastened to the top of the maze The whole apparatus is then composed of two pieces of luggage which may be carried readily by one person

The electrical circuits are indicated in Figure 2 The dashed lines enclosing three parts of the circuit represent the three units of the apparatus A, B, and C The maze box shows six rows of contacts, the remaining two being indicated by the dotted lines One side of the contacts is connected to a common lead represented by the heavy line while the other side of each contact is connected through the cable to the corresponding jacks of the control box Each row of jacks has a set of four plugs, each type of which terminates in one pair of plugs at the extreme right of the diagram These latter plugs may be inserted into any of the four sets of jacks provided (1, 2, 3 and 4) These outlet jacks connect, through the flexible connecting cable, to the indicator unit by means of a multiple plug and jack system Each of these four circuits terminates in a relay and a cam operated contact switch. Each of the four relays controls a single throw double contact make switch The common lead (heavy line) connects one side of the stylus contacts to one contact point of each relay and to the low voltage DC supply.

To indicate the method of stimulus control let us activate the circuit controlling Relay 4. A control box plug having four identification stripes is inserted into one of the jacks, for example, (D) in the diagram Plug (E) is inserted into jack (*4*) and the switch (F) is closed If we wish a buzzer signal, plug (G) is connected to jack (H) and plug (I) to jack (J) Any one jack in each row of four in the control box may be connected to the buzzer circuit by inserting the plug connected to the Relay 4 circuit It is obvious

that any one stylus hole in each row of four may be connected to Relay 4. Inserting the stylus into one of these holes closes the contact to the heavy line, or common lead connected to the battery, and to one side of the relay coil. The other side of the relay coil is directly connected to the battery, hence, closing the stylus contact closes the relay, and the contacts (K) and (L). When the stylus is removed from the hole resulting in the opening of the circuit, the relay remains closed because contacts (K) and (L) connect to cam contacts (M) and thence back to the relay coil. This is simply a holding relay circuit. The relay contacts (L) close the 110-volt circuit to the upper telechron motor. Since this motor turns the cam wheel operating switch (M) at 60 *RPM*, one second after the relay is closed, the contacts at M are broken, the relay releases and the subject may proceed with his next choice. Connected to the relay contact (K) is the buzzer (I plugged into J). Since the relay remains closed for one second, the buzzer will sound for one second whenever a stylus contact connected to this circuit makes contact. Lights, shock, or any other electrical device could of course be substituted in this circuit. This standardization of the time interval for the delivery of a signal provides a definite advance over earlier equipment in which the time interval is dependent upon the length of time that the subject maintains a contact with his stylus.

The error indicator circuits are slightly more complicated but are controlled by exactly the same principle as outlined above. The cumulative error indicator is activated by a reversible telechron motor having a 60 *RPM* cam wheel. If, for example, Relay 2 controls the error direction of the indicator, and we wish to have a buzzer sound for each error made, we may connect the error indicator to the stylus holes that were plugged for Relay 4 above by inserting the unused plug of the pair (E) and (N) into jack (2) which controls Relay 2. Thus, we have added the error indicator to the first set-up (buzzer only) by the insertion of one plug (N). *Whenever either Relay 3 or 4 is used in conjunction with Relays 1 or 2, Switch (F) or (O) must be opened, depending upon which relays are connected in parallel.* This is necessary in order that both relays may be controlled by the cam switches of the error indicator, otherwise the overlapping which might occur in the two cam systems would continue to hold the relays closed after the termination of one second. If the stylus contacts connected to this

circuit are now closed *both* Relay 4 and Relay 2 close The reversible telechron motor will make one revolution, whereupon the cam switch (P) is opened and the relays release Of course the buzzer will sound during this interval Since the reversible telechron motor is connected to the error hand through a 30:1 reduction gear, the hand moves one-thirtieth of the circumference of the dial during the one second interval, as shown in (*C*), Figure 1, this movement is clockwise in the case of errors, counter-clockwise in the case of correct contacts

When Relay 1 is connected into the circuit it subtracts one error each time it is activated In a manner similar to the above description, various stimulus signals for relay Circuits 2 and 4 may be combined with the error subtraction system

The following is a typical set-up One hole in each row is designated as "correct", each time the stylus is inserted into one of these correct holes the error indicator subtracts one error by moving in a counter-clockwise direction At the same time the green lamp attached to the maze box lights The other holes in each row are errors, and each time they are chosen a red light and an accompanying buzzer are turned on and the error indicator registers one error Another set-up which has been used differentiates not merely between correct choices and errors, but also uses differential signals (e g., buzzers of differing intensity) for the several error holes It is understood of course that at each choice point (involving a row of four holes) the subject must locate the correct hole before he can go forward to the next choice point

The error indicator unit may be used for other purposes, the operating technique being merely to close a circuit between (*Q*) and any one of the four jacks at (*R*).

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The Journal of Genetic Psychology, 1939, 55, 229-240

BOOKS

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CRITICAL REVIEWS OF RECENT BOOKS

(*Munn, Norman L Psychological Development New York Houghton, Mifflin, 1938. Pp 582*)

REVIEWED BY GLADYS C SCHWESINGER

The author includes in this book an extensive amount of material which hitherto has been scattered in many sources, or coordinated in part only in other and less comprehensive groupings Within the limits of the framework which he sets for himself, he seems to have omitted nothing of importance from his compilation of research data in developmental psychology. His arrangement of material is orderly and sequential and vastly more comprehensive than is to be found in any other book on developmental psychology known to this reviewer Development is surveyed at first phylogenetically and then carried through ontogenetically The growth of mind, or adaptive behavior is traced from its first simple unicellular beginnings through various levels of animal life from paramnesium to primate, and through human developmental levels from original sperm and ovum, through zygote, embryo, infant, child, adolescent, adult, and on even into senescence All this material is drawn from present, and often very recent, experimental evidence Special stress is laid upon the rôle of symbolic processes, of gesture, language and written speech at the human level, in the growth of intelligence, thinking, and social adaptation, basic to personality development This spread makes the book of interest to the biologist, the psychologist, the psychiatrist, and the educator The volume will prove useful as a text for courses in child development, as a supplement in the genetic bases of educational psychology, and animal psychology, and as a reference book for other basic courses in psychology

Reading this book will not be easy, especially for the beginning student As its reach of interest and factual value carries through to the most advanced student, even to the expert, it will vary in importance in proportion to the background of preparation and specialty or breath which different readers will bring to it Extensive bibliographies at the end of the book and selected citations at the end of each chapter lead to further references and source materials

The general approach is that adult human behavior can be best understood through a proper understanding of the bases and principles underlying the evolution of psychological behavior in animals, and

that these principles can be followed in the development of the human individual from conception to birth, following which event, attention must be directed to studying the sensory, motor, symbolic, and emotional processes, which development, in turn, illuminates the nature and development of the socialized personality

The initial zygote, representing the biological bequest of each parent, developing in an optimum uterine environment, is influenced for better or worse in its growth towards characteristic structure by intra-cellular, inter-cellular, and external conditions of development Disturbance of any one condition will result in anomalous structure and corresponding behavior. Alteration of intra-cellular conditions—for example, in the cytoplasm and related substances holding the genes may be lethal or less seriously detrimental; secretions from the organism's own endocrines are inter-cellular factors which may disturb the development of the organism, while even the relative constancy of the prenatal environment may be subject to glandular, nutritional, or mechanical intra-uterine influences strong enough to affect development The contribution of the post-natal environment needs no elaboration here The relationships of environment and heredity are so integrative that their respective services to the developing organism can be defined only by the terms "determining" and "limiting"

The pattern of much living behavior emerges from the interaction of genes and internal environmental conditions, or in other words, from sheer maturation Other patterns of behavior, however, require practice or models for their eduction Tropistic behavior is the unlearned orienting of the whole organism to an external stimulus; reflex behavior is the unlearned specific response of a part of the organism which must possess a receptor-effector nervous system Instinctive behavior involves unlearned coordinations of reflexes in terms of physiological "needs" or "drives" to activity, the direction being "learned" New structure and new forms of unlearned behavior result from imitation Plasticity of response increases in capacity from lower to higher forms of life, culminating in the human baby, in whom the brain becomes the dominating structure in determining behavior pattern But with the higher stages of evolution goes greater helplessness at birth and the need for a longer period of dependence and training. In the human individual, some behavior patterns emerge after birth as a result of maturation of structure

Plasticity, or the capacity to adapt in non-stereotyped ways, implies intelligence, of which the bases are sensory, motor, and neural structures and functions Munn goes into considerable detailed discussion, with good pictorial illustrations of the evolution of the sensory, motor, and neural processes throughout the animal world. He stresses, in addition to the superiority of the human central nervous system, the specialization involved in man's upright posture, the separation of his manipulative functions from those of vocalization in mouth and throat structures, and the prehensile hand, as preparation for the human heritage of the ability to develop language and to use tools

The degree to which an organism can be modified in accordance with changing situations—that is, the level of complex performance attainable—is a measure of intelligence level Testing device and procedures are discussed for measuring adaptation at different levels of animal life, from unicellular up Infra-mammalian vertebrates evidence nothing higher than simple sensori-motor reactions Mammals show increasing ability in complex manipulation from rat and guinea pig through cat and monkey to man Primates give indication of the first evidence of so-called ideational behavior, especially as seen in delayed-reaction experiments

At the level of the human being, where structural and functional developmental progress and differentiation are given in great detail from zygote to fetus, Munn concludes that it would be premature to generalize as to individuation of reflexes from previous total behavior pattern Here the need for further research is stressed

Very little is included on recent conditioning experiments before the post-natal stage of growth is reached In infancy, ontogenetic activities develop in response to functional maturity and exercise Activities of phylogenetic origin respond more directly to the influence of maturation Learning in childhood is characterized by the elimination of inadequate reactions and an increased and more economic integration of the adequate Typical learning curves and theories of learning are presented.

Data are summarized on the olfactory and gustatory sensitivity of the infant (where such data exist), on the developmental reactivity of the infant to light intensity, at different ages; on auditory responses and temperature sensitivity, on the emergence and development of spatially coordinated behavior and its dependence on

different sensory processes at different ages, on normative motor activities, arranged according to biographic sequence

The acquisition and use of symbolic processes differentiates human intelligence from the sub-human Representative studies on memory, imagery, concept formation, thinking, and reasoning capacities are introduced

The chapter on speech is extensive and includes detailed description and illustrations of the mechanisms underlying language acquisition and expression, as well as discussions of the developmental emergence of speech in the child

The symbolic content of human intelligence is reflected in the psychologists' tests of intelligence Some typical tests are described Individual differences in mental growth and factors underlying the development of intelligence are examined in relation to variations in nature and nurture, the former being responsible for greater differences in intelligence than the latter

Under emotional development are considered the physiological bases, glandular influences and disturbances, social conditioning, not to mention maturation especially as noted in some blind subjects Emotional behavior becomes more complex as sensori-motor and symbolic activities increase, as development proceeds all along the line

The two concluding chapters gather up the aspects of development which, up to this point, have been considered separately, into a synthesis and present the matter of the socialization of the personality as revealed through research and experimental observations in infants and children. Various methods of studying personality are considered, as also the constancy of the personality longitudinally Maladjustments and other forms of compensation arising from thwartings of the self are evaluated.

A brief and critical presentation of materials on adolescence, adulthood, and senescence brings to a close this vast compendium From the single first cell to senility, from unicellular organisms, whose capacity for development never proceeds beyond the initial stage, to the multiple-cellular complexity of the matured human being, the potentials of man stand revealed, as of today's date.

What lies beyond in the possibilities of human development, especially on its psychological side, is promise, but promise well founded upon the remarkable capacity of the human nervous system to adapt,

to make use of symbolization, to invent new techniques of expression which in themselves will offer new opportunities for exercise of capacities inherent in the organism and as yet undeveloped When the psychological development of man is seen in its phylogenetic perspective, a new respect for evolution is easy to acquire When the achievement capacities of men who vary from the norm are considered in their natural and nurtural settings, a new hope for greater general development of the genus homo is much easier to entertain The science of psychological development points the way Munn does not concern himself with the future of man But it is doubtful if any conscientious reader of his book could reach the last page without doing a little wondering on his own account, not, it is true, on how to create the superman, but on how to arrange ordinary man's biological potentials and the environment which he has already built up for himself in such a way that they work together integratively to encourage psychological development a little beyond its present level Certainly, alteration upwards is a not unfair expectation to make for the genus which has mastered in individual representatives, and as a whole, the varying complexities of symbolization and civilization which have already evolved

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Founded by G. Stanley Hall in 1891

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Child Behavior, Animal Behavior, and Comparative Psychology

EDITED BY
CARL MURCHISON

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(Manuscripts are printed in the order of final acceptance)

(over)

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The Journal of Genetic Psychology, 1939, 55, 243-268

THE DEVELOPMENT OF SIZE DISCRIMINATION BETWEEN THE AGES OF 12 AND 40 MONTHS[*]

Department of Psychology, Hunter College

LIVINGSTON WELCH

A. INTRODUCTION

Two outstanding studies on the child's development of the concepts of magnitude are those by Hicks and Stewart (2) and Thrum (4). The first was a series of tests designed to estimate the child's concept of middlesizeness. They were given to 40 children ranging from two to five years of age. The test materials consisted of six boxes of the same color which varied proportionally in three-dimensional size. Each series was presented in such an order that after a child had learned to select the middle size box in one group, he was shown a new combination from which the largest box of the previous series had been dropped and a new smallest box added. At the beginning of each test he was shown the proper object and told *"This is the middle size box—Remember, a toy will always be under the middle size box."* The purpose of the tests was to discover which children utilized the concept of middlesizeness independent of a particular box. The middle size box in the first series was the large box in the second series, but the size proportions of all boxes in all of the series were the same.

Hicks and Stewart found that only one of the 10 two-year-old children were able to identify the middlesize box in any series, that once a child learned to pick out the middlesize box in the first series he generally succeeded in any of the series. They also discovered that there was a high correlation between the ability to discriminate middlesizeness and general intelligence.

Thrum's study was also made on children ranging from two to five years of age. Her problem was to investigate the child's development of the concepts of big and little, as well as middlesize, irrespective of the particular size presented. In her tests different types of shapes were used for each series—toy cars, circles,

*Received in the Editorial Office on September 5, 1938.

squares. Her methodology was very similar to that of the other experimenters and involved the use of auditory stimuli. The Thrum experiment indicated that more children were familiar with the idea of big in relation to the other two sizes The scores showed 88 per cent correct choice for big, 68 per cent for little and 48 per cent for middlesize, where the percentage of error involved 20 chances for each test

B The Problem

The object of this study was to measure the gradual development of finer concepts of large, small, middlesize, wide, and narrow in the minds of the same children over a period of many months This was done by giving tests with calibrated material at intervals of from one to four weeks

The results of tests made on these children were compared with those given to a control group, which included mental defectives as well as normal children who ranged in age from 22 to 40 months. The control group tests were given only once and preceded by 10 conditionings The comparison of the tests of these groups indicated how much the experimental group had learned by repeated testing as compared with the normal development of magnitude discrimination between the ages of 22 and 40 months

Our tests differed from those of Hicks and Stewart and Thrum in the following respects (*a*) The age range of our subjects was lower (*b*) No language was used in any of our tests (*c*) The children were conditioned to find the candy under the same box in every test of our Grade *A* series In our Grade *B* series the candy was changed after each trial from one of the two boxes to the other Here the children received their only cue from being permitted to gaze for five or six seconds at the candy in the box which was to hide it in the next trial These series were designed for a comparison of the development of elementary formal conditioning with the ability to discriminate between large and small on the basis of the memory, of where the candy was last seen (*d*) Our tests for large and small were calibrated (*e*) Our "middlesize" tests differed from those of Hicks and Stewart not only on account of their omission of language but because the *same* middlesize box was used throughout this entire series Going from the lowest to the highest test in this series, the larger boxes become

smaller and the small boxes become larger. (*f*) We added to our battery of tests a series designed to estimate the child's ability to discriminate wide and narrow

C. The Subjects

The tests were given to 24 children from the Home for Hebrew Infants (New York City) and my own child I wish to express my gratitude to this institution for its courtesy and cooperation in allowing me to make these tests and for giving us two testing rooms I am also indebted to Mrs Virginia Seeleman for her assistance and in particular to Mrs Mary Lukomnik who conceived the idea of forming a control group and who directed most of the tests for this group

The experimental group was divided into two sections *"The 12-month section,"* consisting of five children—two boys and three girls— who were tested for a period of from 4 to 12 months; and *"the 3-month section,"* consisting of five children—three girls and two boys—all of whom were tested over a period of three months The home child—Subject 10—belonged to this group

The control group was also divided into two sections, *"The Normal section,"* consisting of 10 children—eight boys and two girls—ranging from 22 months to 32 months, and *"the Subnormal section,"* consisting of five children—all boys—ranging in age from 29 to 40 months The first of these subjects (Subject *A*)—age 34 months—was diagnosed by the institution as being a hypothyroid case He was under treatment before and during the tests Subject *A* was extremely nervous and timid, but quite cooperative He had a fair subvocal vocabulary but no vocal vocabulary. Subject *B*—age 40 months—was another hypothyroid case The physiological symptoms in this case were much more apparent—the enlarged tongue and spatular fingers This child had a small vocal vocabulary Subject *C*—age 40 months—was diagnosed by the institution as a mongoloid Subject *D*—age 29 months—was merely a subnormally dull child Subject *E*—age 32 months—suffered from some major psychosis This last child was unapproachable and completely uncooperative Not once during 20 test periods spread over two months were we able to induce him to even touch an object, much less take any interest in a test He could feed himself and walk, but he had no vocabulary at all and was hypo-kinetic

The Kuhlmann test ratings for all of the children will be found in the tables We gave the Revised Binet test to five of those who were over two years of age, but found that the emphasis which it places on language gave a distorted estimate of their capacities, since all of them lacked opportunities of linguistic development common to the home child We, therefore, omitted this data from the report.

D "The Grade *A*" Tests for the Discrimination of Three-Dimensional Size

1. *The Procedure*

a The materials Nine boxes (all of the same shade of white) were used in these tests as described in Figure 1 Candy was always hidden under Box 1 The lowest test in this scale involved the use of Boxes 1 and 9, Test 1-9, where the child was obliged to distinguish the smallest from the largest The highest test (Test 1-2) involved the use of the smallest box, Box 1, and the next to the smallest, box 2 (see Figure 1)

b. The conditioning. Before any test was given the child was taught to knock over Box 1 and pick up the candy The large box was kept about a foot away either to the left or to the right of the conditioning box. There was a special reason for using double stimuli during the conditioning period In our preliminary investigation we found that if we used but one stimulus, namely, the conditioning box and later, when the test began, introduced the second box, the novelty of this last object incited, in most cases, a special preference for this box.

Each time the candy was placed in Box 1 and rattled for several seconds so that the child would attend to the procedure Ten conditionings were given before every test except in cases where the child had passed one test and was immediately beginning a higher one This change involved nothing more than the substitution of a smaller "large" box for the one that had been used An exception to the rules was also made in the cases of a few very bright children, who, after two or three trials, gave an indication that they did not require further conditioning If such a child failed after but two or three conditionings, he was given opportunities equivalent to the standard 10 conditionings

c. The method of testing The child was placed on the floor

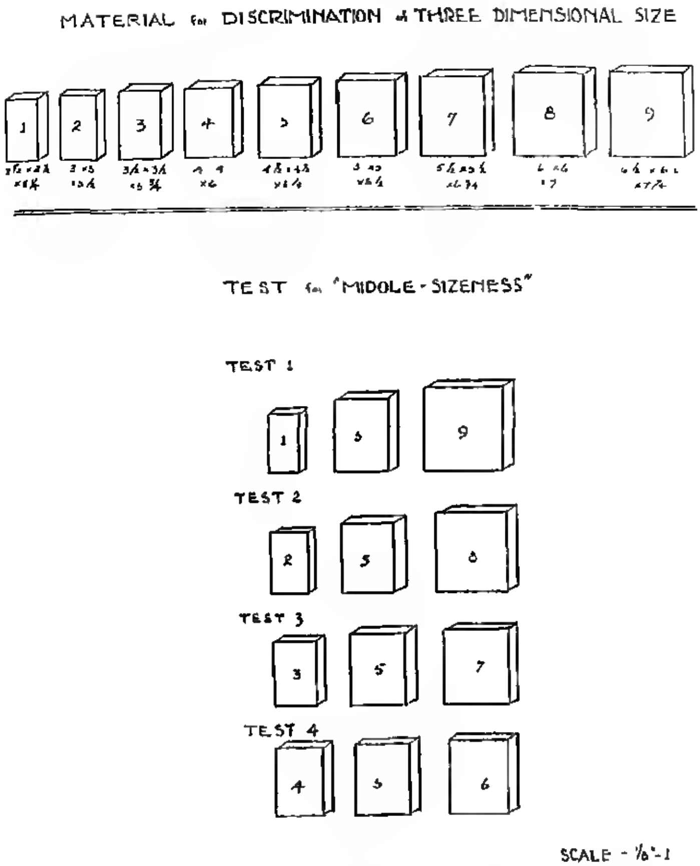

FIGURE 1

MATERIALS FOR DISCRIMINATION OF THREE DIMENSIONAL SIZE, AND TEST FOR "MIDDLESIZENESS"

in a good light and the two boxes were put before him from four to six inches apart. After the conditioning, his attention was distracted and the boxes were set in place on a line. Sometimes, the conditioning box was at the right and sometimes at the left, but an even sequence of changes of position were carefully avoided.

d. The scoring. A child was not considered to have passed a

test until he received at least a score of 90 per cent on 10 trials The reason why the conditionings and the test trials did not exceed 10 respectively, was on account of the limited duration of the interest of our very young children If we had given more than 10 conditionings, as early experience proved, most of the children would have been tired of the test itself before they finished it This was a fact to observe, particularly in the case of the children below 18 months Once a child passed a test he was given the next highest in the scale This was continued until he failed one

If a child passed a test on one day and failed this same test the next, he was still credited with having passed—the tests were rarely repeated—moreover, even if a child were doing well, he was never given tests of the same series for more than two test periods in succession These were on alternate days. We found that continued repetitions of the same type of test destroyed motivation The usual interval for the same type of test was a span of from two to four weeks

e. Praise The children were praised when they succeeded, but were never scolded for failure, since in our preliminary investigation we found that this discouraged them and they often refused to finish the test

2 *Comments on the Results of the "Grade A" Series (See Tables 1 and 2)*

a. Motivation In most cases, strong motivation and pronounced success seemed to go together, regardless of age The successful older children—those above 22 months—enjoyed the test extremely. Subject 1 showed very little interest in the tests during his 13th

TABLE 1
TESTS FOR DISCRIMINATION OF SIZE GRADE A

Experimental group					*Control group*				
Subject	Age	*IQ*	Test	Score	Subject	Age	*IQ*	Test	Score
12-Month Section					*Normal Section*				
1	13 26	106	1-9	60	*RD*	32 21	80	1-8	100*
	13 28		1-9	70				1-5	90*
	13 29		1-9	40				1-4	80
	14 02		1-9	100*					
			1-8	100*	*RS*	32 06	78	1-3	100*
	14 .09		1-2	100*				1-2	90*

TABLE 1 (*continued*)

Experimental group					*Control group*				
Subject	Age	IQ	Test	Score	Subject	Age	IQ	Test	Score
12-Month Section					*Normal Section*				
2	13 18	110	1-9	30	*LI*	31 29	80	1-4	100*
	14 10		1-9	60				1-3	100*
	16 20		1-9	30				1-2	80
	16 27		1-9	90*					
	17 05		1-7	100*	*JH*	31 28	84	1-3	90*
			1-5	100*				1-2	90*
	17 08		1-4	100*					
			1-3	40	*ARL*	29 20	88	1-4	90*
	18 10		1-3	50				1-3	80
	18 26		1-4	40					
	20 25		1-3	80	*DM*	28 03	80	1-9	90*
	21 00		1-3	70				1-6	100*
	23 00		1-3	100*				1-4	100*
			1-2	90*				1-2	90*
3	13 15	104	1-9	30	*AL*	27 23	91	1-4	90*
	13 25		1-9	20				1-3	90*
	14 02		1-9	40					
	14 27		1-9	70	*NP*	26 27	85	1-5	100*
	16 14		1-9	70				1-3	100*
	17 02		1-8	20				1-2	90*
	18 26		1-9	100*					
	19 16		1-5	90*	*6*	23 15	68	1-9	100*
			1-4	80				1-3	100*
	21 12		1-3	100*				1-2	90*
			1-2	90*					
					LS	22 10	91	1-4	90*
4	14 10	76	1-9	20				1-3	100*
	15 02		1-9	70				1-2	70
	15 05		1-9	30	*Subnormal Section*				
	15 22		1-9	60					
	18 02		1-9	60					
	18 09		1-9	100*	*B*	39 22	68	1-9	100*
	18 25		1-6	80				1-5	100*
	19 13		1-7	20				1-4	100*
	22 07		1-3	90*				1-3	90*
								1-2	100*
5	16 28	80	1-9	40					
	17 12		1-9	70	*C*	39 17	35	1-9	90*
	17 27		1-9	70		39 28		1-5	70
	19 01		1-9	100*		40 01		1-8	80
	19 06		1-7	100*				1-7	60
			1-5	100*	*A*	34 15	41	1-9	100*
			1-4	100*				1-7	100*
			1-3	70				1-5	100*

TABLE 1 (*continued*)

Experimental group					Control group				
Subject	Age	IQ	Test	Score	Subject	Age	IQ	Test	Score
12-Month Section					*Normal Section*				
	20 23		1-3	50				1-3	100*
	22 15		1-3	100*				1-2	70
			1-2	60					
	23 18		1-3	100*	*D*	29 05	57	1-9	50
			1-2	70					
	24 13		1-2	60					
	25 02		1-2	100*					
3-month Section									
7	14 19	66	1-9	50					
	15 18		1-9	50					
	16 09		1-9	30					
	16 17		1-9	40					
8	12 24	96	1-9	40					
	13 07		1-9	70					
	13 22		1-9	80					
	14 00		1-9	20					
9	12 14	83	1-9	40					
	13 12		1-9	90*					
			1-8	90*					
			1-7	40					
	13 24		1-7	40					
	14 09		1-7	40					
	14 17		1-7	60					
10	12 04	121	1-9	50					
	13 22		1-9	80					
	14 27		1-9	90*					
	14 28		1-8	60					
			1-8	90*					
			1-7	70					
11	15.18	72	1-9	50					
	16 05		1-9	80					
	16 12		1-9	70					

Note 1—*Means a passing grade

Note 2—We attempted to condition Subjects 1, 2 and 3 in their 12th month, but were unsuccessful It took several weeks before they acquired a taste for the candy

Note 3—Subject 6 and Subject B have the same *IQ* The latter was placed in the *Subnormal section* because of being a hypothyroid case

TABLE 2

AGES AT WHICH THE SIZE GRADE I TESTS WERE PASSED

		Months													
		12	13	14	15	16	17	18	19	20	21	22	23	24	25
Experimental group															
Both Sections	*IQ*														
1	106		1-9	1-2											
2	110		X	X	X	1-9	1-4	1-4	1-4	1-4	1-4	1-4	1-2		
3	104		X	X	X	X	X	1-9	1-5		1-2				
4	76			X	X	X	X	1-9	not below		1-8	1-3			
5	80					X	X	X	1-4			1-3	1-3	1-3	1-2
7	66			X	X	X									
8	96	X	X	X											
9	83	X	1-8	1-8											
10	121	X	X	1-9	1-8										
11	72				X	X									

Control group		22	23	26	27	28	29	31	32	34	39
Normals	*IQ*										
RD	80								1-5		
RS	78								1-2		
IA	80							1-3			
JH	84							1-2			
ARL	88						1-4				
DM	80					1-2					
AL	91				1-3						
NP	85			1-2							
6	68		1-2								
LS	91	1-3									
Subnormals	*IQ*										
B	68										1-2
C	35										1-9
A	41									1-3	
D	57					X					

X—failure in test 1-9—the lowest in the scale

month when he failed the lowest test continually—Test 1-9 In his 14th month, however, he suddenly caught on to the tests and passed even the highest Apparently he had some vague knowledge of his success, which might have been due to the excess praise he was given As a result, he thoroughly enjoyed the tests and whimpered when they came to an end On the other hand, Subjects

9 and 10 passed the lowest and the next to the lowest tests—Test 1-9 and 1-8—during their 14th month, but were unable to succeed with the higher tests These children's motivation was comparatively weak

The motivation of children below 13 months was so negligible that we did not bother to record most of the tests As a rule, it required several weeks before we could cultivate their taste for candy During the 14th, 15th, and 16th months some of the children went into tantrums when their candy was taken from them after each trial Practically all of the children over 19 months, whether successful or not, took a great deal of pleasure in the tests Some went into tantrums after we finished with them and began to test others. Some of the children over the age of 19 months seemed to enjoy knocking over the boxes more than they did eating the candy. Often they would put the candy back in the conditioning box of their own accord without even tasting it

b The earliest success. Only three children out of 11 passed the lowest test before their 16th month.

c. The passing of the highest test, the size differential of which was ½ x ½ x ¼ inches. One child of the "12-month section" of the experimental group passed the highest test—Test 1-2—in his 14th month, another passed it in his 21st month, a third passed it in her 23rd month, a fourth in her 24th month, and a fifth left during his 24th month before he passed higher than the next to last test.

All of the normal children in the control group—ranging in age from 22 to 32 months—passed Test 1-4 and 50 per cent passed the highest test—Test 1-2 Hence, there is no evidence from these tests that the experimental group benefited by the greater number of tests that they received

In the subnormal group, the dull child with an *IQ* of 57 failed the lowest test, which the mongolian idiot passed One of the hypothyroid children passed the highest test and the other passed the next to the highest Thus, it seems that in at least a few cases of mental dullness or deficiency the ability to discriminate three-dimensional size is affected There was, however, practically no general correlation between pronounced success in these tests and a high *IQ*.

d The rate at which their ability to discriminate size developed

In some cases, as for example that of Subject 1, the development of the ability to discriminate was sudden and rapid, while in others it proved to be very slow, as in the case of Subject 2, who for six months could not pass a test higher than 1-4 Note that she passed from Test 1-9 to Test 1-4 between her 16th and 17th month Again, Subject 4 passed the lowest test in his 18th month but did not pass any test higher than 1-8 before his 21st month Subject 5 was so uncooperative up until her 18th month that it was useless to test her, still, in her 19th month she passed not only the lowest test—Test 1-9—but also Test 1-4.

e Sex differences. The proportion of both sexes was by no means equal. All that we can say is there was no indication in our tests of superiority for either sex

E The "Grade *B*" Tests for the Discrimination of Three-Dimensional Size

1 *The Procedure*

a The material The material for tests consisted of the same nine boxes that were used for the Grade *A* series.

b The method The method differed in only one respect Formal conditioning was abandoned. Here the child's discrimination was based on the observation of the box into which he saw the candy placed The scale was the same as in Grade *A* tests, running from Test 1-9 to Test 1-2 If the child was given Test 1-9 Grade *B*, we showed him the candy placed, let us say, in Box 9 first The candy was rattled around in this box for several seconds to attract his attention The experimenter made certain that the child had an opportunity of observing this phenomenon very carefully. The child was also shown the empty box His attention was distracted and then the boxes were set up before him on the floor, from four to six inches apart The scoring was the same as in Series *A*. The Grade *A* and Grade *B* tests were never given to the same child on the same day In nearly every case they were kept at least a week apart, so that the child would not confuse one series with another

2. *Comments on the Results of the Grade B Series (See Tables 3 and 4)*

a Motivation The motivation connected with these tests was no different from that in the first series The Grade *B* tests, how-

TABLE 3

TESTS FOR DISCRIMINATION OF SIZE GRADE *B*

Experimental group					*Control group*				
Subject	Age	*IQ*	Test	Score	Subject	Age	*IQ*	Test	Score
12-Month Section					*Normal Section*				
2	18 09	110	1-9	30	*RD*	32 21	70	1-9	70
	19 19		1-8	70					
	20 02		1-9	70	*RS*	32 11	78	1-9	80
	20 20		1-8	80					
	22 11		1-9	60	*LI*	31 29	85	1-9	80
	22 13		1-9	50					
	23 25		1-9	90*	*JH*	32 03	84	1-9	100*
	24 00		1-8	90*					
			1-6	80	*JRL*	29 25	88	1-9	80
	24 10		1-7	90*					
	25 01		1-6	40	*DM*	28 05	80	1-9	80
			1-6	70					
	25 21		1-6	70	*AL*	27 28	91	1-9	60
	26 00		1-6	70					
					NP	25 25	85	1-9	70
3	18 26	104	1-9	100*					
			1-5	70	*LS*	22 08	93	1-9	60
	20 11		1-9	70					
			1-7	60					
	22.02		1-8	80	*Subnormal Section*				
	23 06		1-9	90*					
			1-8	80	*B*	40 10	68	1-9	50
	24 12		1-9	100*					
	24 16		1-7	100*	*C*	40 05	35	1-9	60
			1-5	80					
	24 27		1-6	90*	*I*	34 18	41	1-9	90*
			1-5	60				1-8	80
	25 16		1-5	90*				1-7	70
			1-4	50					
	26 00		1 4	50	*D*	29 08	57	1-9	60
4	19 21	76	1-9	50					
	21 07		1-9	80					
	22 22		1-7	80					
	24 01		1-9	80					
			Left before he passed						
5	18 26	80	1-9	70					
	19 00		1-9	10					
	20 22		1-9	40					
	22 06		1-9	60					
	23 10		1-9	80					
	23 21		1-9	80					
	24 14		1-9	40					
	25 06		1-9	50					

TABLE 3 (*continued*)

Subjects	Age	IQ	Test	Score
	Experimental group			
6	24 04	68	1-9	80
	24 15		1-9	80
	25 03		1-9	80
	26 03		1-9	50

Note—*Means a passing grade

ever, were not given to any children below 18 months, since they were more difficult

b The earliest success. One child in the experimental group passed the lowest test in his 18th month and another in her 23rd month In the control group one of the normal children passed the lowest test in his 32nd month and one of the hypothyroid cases passed it in his 34th month Only 4 out of the 24 children passed any of these tests—three boys and one girl.

TABLE 4
AGES AT WHICH THE SIZE GRADE *B* TESTS WERE PASSED

Subjects		18	19	20	21	22	23	24	25	26	32	34
						Months						
	IQ					*Experimental group*						
2	110	X	X	X	X	X	1-9	1-7	1-7	1-7		
3	104	1-9	1-9	1-9	1-9	1-9	1-9	1-6	1-5	1-5		
						Control group						
Normal	*IQ*											
JH	84										1-9	
Sub-normal	*IQ*											
A	41											1-9

X—Failure of the 1-9 test—the lowest in the scale

c The highest test passed The highest test passed was Test 1-5 by one child The next highest was Test 1-7 The size differential in the first case was 3 x 3 x 1¼ inches and in the second case, 2 x 2 x 1 inches

d The correlation with general intelligence The fact that the children with the highest *IQ*s in the experimental group were the ones who passed some of these tests suggests some sort of correlation with general intelligence—still, the one child in the control group who passed had the third lowest *IQ* Moreover, a child with an *IQ* of 41 passed the lowest test in his 34th month

F. Tests for Middlesizeness

1 *The Procedure*

a *The material* The same boxes that were used in the other tests

b *The conditioning.* The child was conditioned 10 times to knock over Box 5 throughout this entire series and to pick up the candy hidden under it. While this conditioning was taking place, the large and the small boxes were present for the same reasons that we mentioned in connection with the Grade *A* tests

c *The sequence of these tests.* This series had four tests as described in Figure 1—*Test 1,* which made use of Boxes 9, 5, 1; *Test 2,* which made use of Boxes 8, 5, 2, *Test 3,* which made use of Boxes 7, 5, 3; and *Test 4,* which made use of Boxes 6, 5, 4 Each test had 10 trials

d. *The scoring* was the same as in the other tests

e *The position of the conditioning box in the tests* The position of the conditioning box varied from trial to trial, Sometimes it was in the middle, and sometimes at the right or left of either the large or small box

2 *Comments on the Results of the Tests of Middlesizeness (See Tables 5 and 6)*

a *The motivation* The motivation did not seem to be as strong as in the other tests, but it was by no means weak. No child below the age of 22 months was given this series of tests Hence, we did not have the problem of motivation that we had with the very young children in connection with the Grade *A* tests

b. *General achievement.* Whereas only one of the 10 two-year-old children given the Hicks and Stewart middle size tests were successful, only three out of 17 of our children below the age of 41 months passed any of our tests One was a hypothyroid case 34 months old and the others passed the lowest test by their 24th month The Hicks and Stewart tests involved language, while ours were based on conditioning below the linguistic level. In commenting on the Hicks and Stewart experiment, Munn (3) says

> One may ask, "Is the great inaccuracy for *Middle* due to inadequate vocabulary, or is it due to inability to discriminate *Middleness?*" Infra-human animals have been trained to discriminate the middle brightness, the middle size, and the

TABLE 5

TESTS FOR THE DISCRIMINATION OF MIDDLESIZENESS

Experimental group					*Control group*				
Subject	Age	*IQ*	Test	Score	Subject	Age	*IQ*	Test	Score
12 Month Section only					*Normal Section*				
2	23 19	110	1	90*	*RD*	32 21	80	1	80
			4	30					
	24 08		1	80	*RS*	32 13	78	1	80
	25 01		2	80					
	26 00		2	50	*IA*	31 29	80	1	30
3	23 27	104	1	80	*JH*	31 28	84	1	70
	24 23		1	90*					
			3	90*	*ARL*	29 27	88	1	40
	24 27		4	60					
	25 18		4	50	*DM*	28 03	80	1	50
	26 00		4	40					
					AL	28 00	91	1	40
5	22 25	80	1	40					
	23 21		1	40	*NP*	26 25	85	1	40
	24 12		1	40					
	25 04		1	20	*LS*	22 08	93	1	20
6	23 18	68	1	40	*Subnormal Section*				
	24 19		1	50					
	25 03		1	20					
	25 10		1	20	*B*	40 13	68	1	40
	26 05		1	40					
					C	40 05	35	1	40
					A	34 20	41	1	100*
								2	100*
								3	80
					D	29 03	57	1	20

Note—*Means a passing grade

TABLE 6

AGES AT WHICH THE MIDDLESIZE TESTS WERE PASSED

Subjects		Months				
		23	24	25	26	34
Experimental group	*IQ*					
2	110	1	1	1	1	
3	104	X	3	3	3	
Control group—subnormal						
A	41					2

X—Failure of Test 1—the lowest in the scale.

> middle weight of three stimuli If children were tested by similar methods we might find that the "concept" of middleness can be acquired at a much earlier age than is indicated by (the Hicks and Stewart) experiments

Our tests may give some suggestion of the answer Despite testing below the linguistic level, our results were very similar to those of Hicks and Stewart.

c. The correlation with general intelligence The same children of the experimental group with the highest *IQ*s who passed some of the Grade *B* tests passed some of these also Again, the hypothyroid child with an *IQ* of 41 passed the first two tests of this series

d The experience of the experimental group The repetition of the tests seemed to have a slight bearing on the success of two of the children, but those who passed the first test passed it on the *first attempt.*

e. A comparison of tests Obviously, Grade A discrimination comes much earlier than Grade *B* or discrimination of Middlesizeness, still, we have no evidence to support the fact that there is an appreciable difference between the genesis of Grade *B* and Middlesize discrimination

f Hicks and Stewart have shown that if the size differentials between the three boxes remain the same, a child who can discriminate Middlesizeness with a large set of three boxes can do the same with a small set. The dimensional proportions varied in our tests and children who were able to discriminate Middlesizeness when the size differentials were great, e.g, the differentials between Boxes 9, 5 and 1, were unsuccessful in tests where the size differentials were small, e g, the differentials between Boxes 6, 5 and 4

G TESTS FOR THE DISCRIMINATION OF WIDTH

1. *The Procedure*

a The material. The apparatus described in Figure 2 was made in four sets and the set numbers corresponded to the test numbers Set 1 had a 10-inch wide section and a 2-inch narrow section, Set 2, a 7-inch wide section and a 2-inch narrow section, Set 3, a 5-inch wide section and a 2-inch narrow section; Set 4, a 3-inch wide section and a 2-inch narrow section Each section on all of the sets had a wooden hinged flap of proportional size on both the front

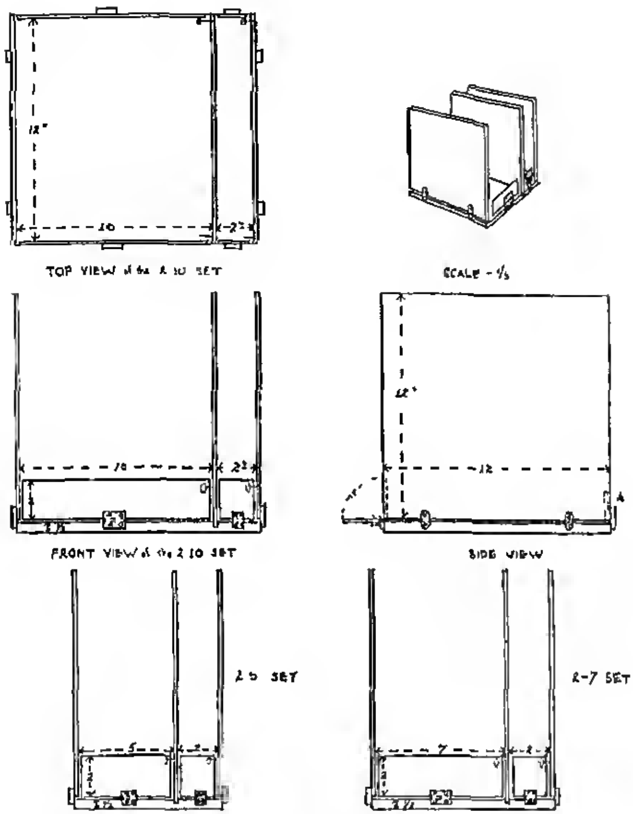

FIGURE 2
APPARATUS FOR TESTING DISCRIMINATION OF WIDTH

and the back of these sections, in order that the set might be turned around to change the position of the sections from one side to the other

The only dimensional variable in any one set was width All other dimensions were the same. The height of all of the flaps was the same. No perception of depth was necessary, for the children were conditioned merely to the act of pulling down the narrow flap.

b The conditioning Every child had 10 conditionings. Prior to the conditioning he was given three or four demonstrations The

experimenter pulled down the small flap, picked up the candy hidden behind it and put it in the child's mouth. The conditioning consisted in inducing the child to pull down the flap himself During the conditioning, the set was turned around so that sometimes the conditioning flap was on the left and sometimes on the right The child was never scolded when he made the wrong choice, but, usually, he received no candy when he failed There were some exceptions, as when a child was distracted and we solicited his attention several times by giving him the candy after we had placed his hand on the right flap

c The method of testing After the conditioning period, the child's attention was distracted and while the set was half turned the experimenter slipped the candy behind a narrow flap at an angle at which the child could not see the act even if he were looking The apparatus was always placed high enough so that the bottoms of the flaps were about the same level with the subject's eyes. This prevented him from peeping over the top. He was given the candy when he succeeded and was praised

d The scoring The scoring was the same as in the other tests, 90 per cent was passing, and each test consisted of 10 trials

2. *Comments on the Results of the Tests for the Discrimination of Width (See Tables 7 and 8)*

a. The motivation The motivation in these tests was on a par with that which we have discussed in connection with the Grade *A* tests. The very young children—those below 17 months—showed a small amount of interest in the tests, but the older children enjoyed them very much

b. The earliest success Out of nine children in the experimental group who were given the lowest test before the age of 17 months, only three passed—one at 15 months and the others at 16 months A fourth child passed the lowest test at 17 months and the next did not succeed until the 21st month. Unfortunately, there are some gaps in the tests given to the experimental group—gaps in one or two instances—of from three to five months This might suggest that these children were not given the same opportunities to become acquainted with the apparatus for width that they had with the Grade *A* apparatus This is not so. During those months when the formal width tests were not given to these children, they were

TABLE 7

TESTS FOR THE DISCRIMINATION OF WIDTH

Experimental group				
Subject	Age	IQ	Test	Score
12-Month Section				
1	14 09	106	1	80
	14 23		1	40
	15 02		1	90* (left soon after)
2	13 28	110	1	30
	14 26		1	80
	16 13		1	90*
	17 00		2	70
	23 19		1	90*
	24 08		3	50
	24 10		2	100*
			3	90*
	24 13		4	100*
3	14 16	104	1	20
	15 16		1	40
	16 00		1	100*
	16 16		2	80
	17 07		3	50
	23 28		1	90*
	24 25		3	80
	24 28		2	80
	25 00		4	50
	25 18		3	90*
			4	60
	26 00		4	100*
4	15 11	76	1	30
	17 00		1	60
	17 25		1	90*
	18 02		3	50
5	19 19	80	1	30
	22 28		1	100*
	23 23		1	100*
	23 25		2	100*
	24 00		3	100*
			4	70
	24 16		4	100*
6	23 22	68	1	70
	24 17		1	90*
	24 19		2	90*
	24 23		3	80
	25 10		3	90*
			4	60
	26 03		4	50

Control group				
Subject	Age	IQ	Test	Score
Normal Section				
RS	32 15	78	3	100*
			4	90*
IA	32 08	80	2	100*
			3	100*
			4	100*
JH	32·07	84	2	100*
			3	100*
			4	70
ARL	29 29	88	3	90*
			4	60
DM	28 12	80	2	90*
			3	90*
			4	60
AL	28 02	91	2	100*
			3	60
			4	70
NP	27 04	85	2	90*
			3	90*
			4	100*
6	23 32	68	1	70
LS	22 07	93	1	100*
			2	80*
Subnormal Section				
B	40 17	68	1	90*
			2	100*
			3	80
C	40 12	35	1	90*
			2	90*
			3	80
A	34 20	41	1	100*
			3	100*
			4	90*
D	29 06		1	60

TABLE 7 (*continued*)

Subject	Age	*The experimental group* IQ	Test	Score
3-Month Section				
7	15 08	66	1	0
	16 00		1	10
	16 12		1	0
8	12 26	96	1	40
	13 22		1	20
	14 00		1	10
9	13 14	83	1	40
	14 06		1	10
	14 17		1	20
10	14 20	121	1	50
	15 19		1	40
11	15 08	72	1	20
	16 03		1	30
	16 06		1	20

Note—*Means a passing grade

verbally conditioned to the small flap on Sets 2 and 3 Incidentally, the conditioning was unsuccessful but it increased the children's acquaintance with the apparatus and involved no confusion between the verbal width tests and the ordinary width tests

In the control group only one of the normal children (age 23 months) and only one of the four subnormal children (age 29 months) failed the lowest test.

c. The highest tests passed. In the experimental group, three of the children of the 12-month section passed the highest test—whose size differential was one inch—by their 26th month. Two of them passed it on their 24th month

In the control group, only three of the nine normal children passed it—one in her 27th month and the others in their 32nd month; one of the hypothyroid children passed it in his 34th month.

d. A comparison of the three dimensional and one dimensional tests

(1) In the experimental group, five children passed the *lowest Grade A test* before the *lowest width test,* two passed the *lowest width test* before the *lowest Grade A test,* and one child passed both at the same time.

TABLE 8

THE AGES AT WHICH THE WIDTH TESTS WERE PASSED

Subjects Both Sections	*IQ*	Months 12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
							Experimental group									
1	106			X	1											
2	110		X	X	X	1								4		
3	104			X	X	1							1	1	3	4
4	76					X	1									
5	80								X			1	2	4		
6	68												X	2	3	3
7	66				X	X										
8	96	X														
9	83		X	X												
10	121			X	X											
11	72				X	X										

Subjects	*IQ*	Months 22	23	27	28	29	30	32	34	40
				Control group						
Normals	*IQ*									
RS	78							4		
IA	80							4		
JH	84							3		
ARL	88					3				
DM	80				3					
AL	91				2					
NP	85			4						
6	68		X							
LS	93	1								
Subnormals	*IQ*									
B	68									2
C	35									2
A	41								4	
D	57					X				

X—Failure on Test 1—lowest in the scale

(2) In the experimental group, three children passed the *highest Grade A test* before the *highest width test,* and one passed the *highest width test* before the *highest Grade A test.*

(3). In the control group six children passed higher in the Grade *A* tests than they did in the width tests, and four passed higher in the width tests than they did in the Grade *A* tests Three did as well in one as the other.

The significance of these results depends on the correct estimation of the relationship of the size differential in both types of tests These may be studied in Table 9

TABLE 9
SIZE DIFFERENTIALS

Tests	Grade *A* differentials	Tests	Width differentials
1-9	4 x 4 x 2 inches	1	8 inches
1-8	3½ x 3½ x 1¾ inches	2	5 inches
1-7	3 x 3 x 1½ inches		
1-6	2½ x 2½ x 1¼ inches		
1-5	2 x 2 x 1 inches	3	3 inches
1-4	1½ x 1½ x ¾ inches		
1-3	1 x 1 x ½ inches		
1-2	½ x ½ x ¼ inches	4	1

There is no way in which we can prove that the size differentials of the lowest tests of the Grade *A* series and the lowest tests of the width series are equivalent We can merely state that the children who passed the Grade *A* lowest test first may have found the differentail 4 x 4 x 2 inches easier than the differential 8 inches In the three dimensional realm two of the dimensions were one-half as great and one dimension was one-fourth as great as that of the one dimensional realm. On this basis it would seem there was a slight tendency for the children to grasp concepts of three dimensions before they entertained concepts of one dimension

e Size preference. Any score above 80 per cent or below 20 per cent is decidedly indicative of either conditioned discrimination or preference for the size of one of the boxes or the flaps on the width apparatus. Obviously, the low score of 10 per cent or of 0 could merely signify a strong preference. The only evidence we found to support the conclusion that the scores above 80 per cent were not governed by preference was of a qualitative nature All of the children who ran high scores deliberated before making a choice Often, they would reach for the wrong box or flap and suddenly turn to the right one Those who ran very low scores such as 20 per cent, 10 per cent and 0 immediately grasped the wrong box or flap soon as the "set-up" had been made

As the tables show, all of the five children in the *"3-month section"* of the experimental group manifested strong preferences for

the *large flap* in the Width tests—scores of 20 per cent, 10 per cent and 0 In the *"12-month section"* of this group only one of the six children ran a score below 30 per cent and this happened on but one occasion

The same 11 children in the experimental group showed much less preference for the large box in the Grade *A* tests Only three of them ever ran a score lower than 30 per cent

The preferences imply an elementary form of discrimination We, however, are making the distinction between the type of discrimination involved in a choice based on preference and the type of discrimination which is involved when a child associates a visual or auditory phenomenon foreign to the apparatus with the magnitude of a specific part of the apparatus, e g , the sight of candy associated with the size of flap or the box Hence, we are not considering the "Preference" type of discrimination in our general comparison of the results of the four series of tests.

Throughout the tests the pleasure that the children 13, 14, and 15 months old manifested for candy was not as great as that of the older children, but it was decidedly stronger than that which they experienced from pulling down any of the flaps of the width apparatus or of turning over the boxes By the time that we began the tests it was not necessary to coax them to eat candy, but often, much urging was needed in order to persuade them to pull down the flaps or turn over the boxes. Hence, the preferences for the large flap or the large box did not seem to be the result of the domination of the desire to pull down the large flap over the desire to find the candy, but instead, the manifestation of the children's inability to associate the candy with the conditioning flap or box

f Sex differences There was no evidence of any sex differences.

g Correlation with general intelligence. There was no significant correlation between width discrimination and general intelligence

H Summary and General Comments

1 *The Purpose of This Study*

The purpose of this study was to measure with calibrated material the gradual development of finer concepts of large, small, middle-size, wide and narrow, in the minds of the same children over a period of many months The results of the tests made on these children were compared with those of a control group which included

mental defectives as well as normal children. In all, 25 children were tested, whose ages ranged from 12 to 40 months

2 *The Results*

a The Grade A series.

(1). *The experimental group* Three out of eleven passed the *lowest test* before their 16th month. Here, they were conditioned to find candy that was hidden under a box 2½ x 2½ x 5¼ inches and a box 6½ x 6½ x 7½ inches

By their 24th month, the four children who continued these tests were able to discriminate between a box 2½ x 2½ x 5¼ inches and another 3 x 3 x 5½ inches—the *highest test* in this series.

(2). *The control group* All of the 10 children ranging in age from 22 to 32 months passed the *lowest test* Fifty per cent passed the *highest test.*

In the subnormal sections, three out of four passed the *lowest test* —the mongolian idiot and the two hypothyroid cases.

b The Grade B series

(1) *The experimental group.* Only two out of five passed any of these tests Here, the incentive was changed irregularly from the large to the small box These tests involved no conditioning and the child's only cue was the sight of the candy being dropped into the box which hid it during that trial The Grade *A* series placed all the emphasis on the concept of "small" This series tested equally the explicit existence of both concepts—"small" and "large"

(2) *The control group.* Two out of thirteen passed the *lowest test*—one, a normal child, and the other a hypothyroid The lowest test involved the discrimination between a box 2½ x 2½ x 5¼ inches and one that was 6½ x 6½ x 7¼ inches. One of the children passed this test in his 18th month and the other in her 23rd month. The first child in his 25th month passed *a test higher* than any of the others—a test which involved discrimination between a box 2½ x 2½ x 5¼ inches and one 4½ x 4½ x 6 inches

c The "Middlesize" series Only three out of seventeen passed any of these tests Two of them belonged to the experimental group and one, a hypothyroid case, was a member of the control group One of these children passed the next to the highest test.

d The "Width" series

(1). *The experimental group* Before the age of 16 months, three out of nine passed the *lowest test* which had a size differential of eight inches. Three out of six in the *"12-month section"* passed the *highest test* whose size differential was one inch—by their 26th month One of those, who did not pass this test, left during his 24th month

(2). *The control group.* Only two out of thirteen failed the *lowest test*, one a member of the normal section—age 23 months—and the other a backward child of 29 months.

Three out of nine normal children passed the *highest test*—one in her 27th month and the others in their 32nd month.

In comparing the Grade *A* and width tests of some of the young children, we called attention to the size preferences which they manifested. These preferences implied a form of discrimination, but a form different from the conditioned discrimination for which the tests were devised

e A comparison of the results of all the tests taken by the experimental group can be reviewed in Tables 10 and 11.

f. The development of the ability to discriminate size in all four series was extremely variable Some of the children progressed

TABLE 10

THE AGES AT WHICH THE *Lowest Tests* OF ALL FOUR SERIES WERE PASSED BY THE EXPERIMENTAL GROUP

The symbols, A, B, M, and W represent the Grades A and B Middlesize and Width tests, respectively

	Months											
Subjects	13	14	15	16	17	18	19	20	21	22	23	24
12 Month Section												
1	A		W									
2				A							B	
				W							M	
3				W		A						
						B						M
4					W	A						
5							A					W
6											A*	
3-Month Section												
9	A											
10		A										

Note—"*"—Subject 6 did not enter the group until his 23rd month

TABLE 11

THE ORDER IN WHICH THE LOWEST TESTS WERE PASSED BY THE EXPERIMENTAL GROUP

The numbers 1, 2, 3, 4 represent the 1st, 2nd, 3rd or 4th test to be passed by the same subject If a child passed two different types of tests the same month, both are recorded as 1 or 2 as the case may be

Subjects	Grade *A*	Grade *B*	Middlesize	Width
1	1	–	–	2
2	1	2	2	1
3	2	3	4	1
4	2	–	–	1
5	1	–	–	2
6	1	–	–	2
9	1	–	–	–
10	1	–	–	–

very slowly, some completed a whole series in the course of a few days and the rest progressed rapidly at one period and remained at a standstill at other periods

g There was not sufficient evidence to indicate a high correlation between any of these types of discrimination and general intelligence

h There was not sufficient evidence to indicate any sex differences

i At times, the constancy of certain scores was remarkable A child would be given the same test which he had failed two or three times over a period of three months and received the same score on each occasion

j In the Grade *B*, middlesize and width series, there was some evidence that the frequent repetition of tests given to the experimental group improved their discrimination to a slight extent

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The Journal of Genetic Psychology, 1939, 55, 269-297

THE SPAN OF GENERALIZATION BELOW THE TWO-YEAR AGE LEVEL*

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A. INTRODUCTION

We are chiefly concerned with the elementary stages of concept formation, though we shall begin with the premise that this phenomenon at any stage involves either the conscious or unconscious, verbalized or unverbalized perception of differences and similarities. In the experiments of Munn and Stiening (6) it was shown that children as young as 15 months could discriminate between a square and a cross insofar as they had come to associate the sight of food with one of these symbols and not with the other. Gellermann (2) by similar methods proved that children below the age of two years were able to discriminate between a triangle and a trapezoid. In a subsequent paper we shall furnish data to support the fact that some children below the age of two years can discriminate between a plate 8" x 8" and a plate 8¼" x 7¼". One child was even able to distinguish a plate 8" x 8" from one that was only 8½" x 7½". In all of these experiments both the perception of similarities as well as the perception of differences is present. The investigations, however, are designed to discover how fine a *difference* the subject may perceive.

The equally important question may be raised as to how *slight* the similarity may be between the shape and/or size and/or color of objects before the limit of the infant's generalization is reached. It is a well recognized fact that the infant in learning language usually associates words with a wide variety of species of any one class. For instance, the child who has learned to use the word "chair" or to respond correctly when the symbol "chair" is given to him, at first rarely discriminates between one chair and another. Originally, he may have been verbally conditioned to but one small, straight back chair; still, once the proper association has been built

*Received in the Editorial Office on September 21, 1938.

up, he is likely to identify any chair nearest at hand when the word is uttered.

In our preliminary investigation we discovered that the span of generalization of children below two years of age could often be stretched beyond the limit of what might be regarded as only remotely resembling the shape, color, or size of the original object used during the conditioning. Such an extension of the span required some extra conditioning, but comparatively speaking, an almost negligible amount. Three of our children required between five and six hundred conditionings over a period of two or three months before they responded correctly to the words "chair" and "ball." That is to say, before they picked up or pointed to these objects mixed in among a group of others when their respective symbols were given. We required the children to make at least three successive correct responses on three successive days before we were satisfied that they "knew" the symbols. The average age of these children was 20 months.

When they had been properly conditioned, they were separately shown a folding chair unfolded, which they all recognized as a chair. They were then given the opportunity of identifying the chair in a partially collapsed state. When they were eventually brought into a room filled with various objects but no chair other than the completely collapsed chair they picked it up on their first trials as soon as the word "chair" was uttered. After putting the children through the routine no more than twice on each of two test periods, retests over a period of two weeks indicated that the stretch of their span of generalization as far as chairs were concerned had been firmly established and necessitated no further conditioning. Several months later we attempted the same type of experiment and obtained the same results with a ball that could be deflated. With very little conditioning we were able to spread the association that had taken months to build up in these children's minds between the word "ball" and ordinary balls of different sizes and colors, so that the symbol became associated with the sight of a ball in a completely collapsed state, as well.

B. The Problem and General Procedure

The above phenomenon led us to an attempt at calibrating the span of generalization of our subjects, where generalization was based on similarities of form and area only.

1 *Material*

The material used for these tests was a series of 32 plywood plates. The first was a perfect square 8 x 8 inches, and the last in the series (Plate 32) was a stick 15¾ x ¼ inches Going up the scale, each plate increased ¼ inch in one dimension and decreased ¼ inch in the other dimension. The dimensions of each are given in the mechanical drawing (Figure 1). The first 12 plates

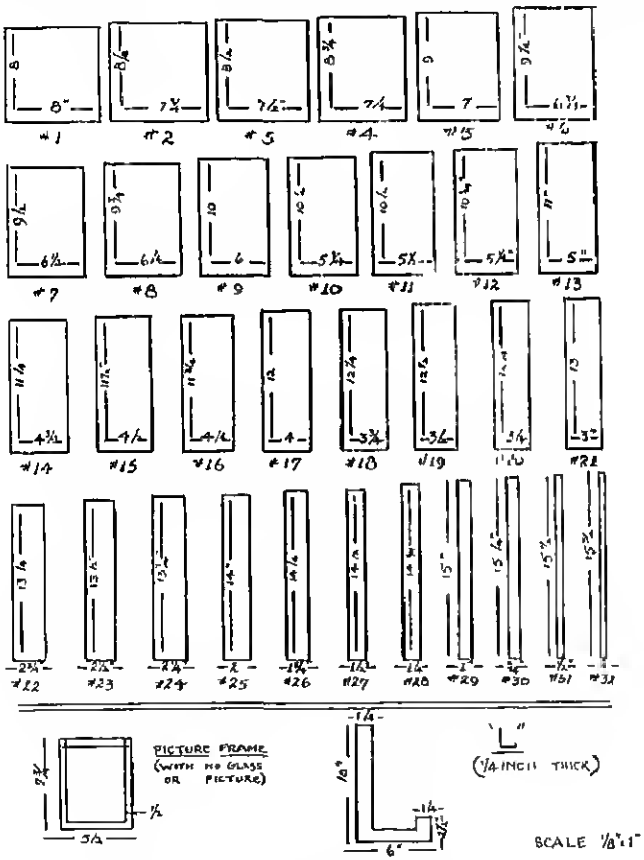

FIGURE 1

MATERIAL FOR TESTING THE GENERALIZATION SPAN

were painted the same shade of red on both sides, Plates 13 to 22 were painted red on one side only On the other sides, the colors varied alternately from black to green to the plain color of the wood and these alternations continued up the scale to the last plate No plate after No 22 had red on either side

2. *The Subjects*

The subjects were between the ages of 18 and 20 months when the tests began The work was carried out at The Home for Hebrew Infants in New York City We acknowledge our gratitude to this institution for its courtesy and cooperation and for the privilege of using two of their test rooms

We limited our study to only four children—two boys and two girls—in order that every step of each test might be described in detail in the report The duration of attention and cooperation required on the part of the child for any significant tests of this sort, discouraged us from selecting subjects younger than 18 months We made several attempts with bright children around the 14th month age level, but failed in completing any of the tests

The subvocal or auditory vocabulary of our subjects when the tests were first started did not exceed 24 words, and in one case was as low as 9 words—Subject 4 Before the tests were completed—about four months later—the maximum increase of the subvocal vocabulary for any of these children was not more than 10 or 13 words Two of them, during the last month—Subjects 1 and 2,—had a vocal vocabulary of not more than four words. Any addition to their subvocal vocabulary required from 10 to 14 days of steady conditioning even at this period The children were not all subnormal Their *IQ*s on the Kuhlmann tests were 110, 104, 80, and 76 The backwardness of their speech was the result of their being in an institution

They were given a total of 30 tests involving 352 trials

3 *Special Procedure*

a The test periods were held on Tuesdays, Thursdays, and Saturdays of every week. For many test periods the child was shown Plate 1, while the symbol *"ate"* was repeated to him anywhere from 20 to over 100 times This conditioning took place on from 6 to 16 different test periods over a span of from one to two months

Differences in the duration of these conditionings may be explained by the fact that some children learned faster than others

b. The method of conditioning The plate was put in the child's hand. He was induced to pick it up. It was bounced in front of him, waved in front of him, etc, while the repetitions of the symbol were slowly and clearly given At the beginning of each test day during the training period, the child was led into a room where Plate 1 was placed in among three or four other objects scattered on the floor

c The criterion for the establishment of the original association When the child unhesitatingly picked up Plate 1 three times in succession under the above mentioned conditions on at least three successive test periods, without making any incorrect choice, we then began the generalization tests, for we considered that a sufficient association had been built up between the symbol *"ate"* and the vision of Plate 1. While the children were being verbally conditioned to Plate 1, they were also verbally conditioned in the same manner to 12 other objects

d. The generalization tests The child was led to a group of objects—four or five—among which lay Plate 32 He was asked for *"ate"* If after five or six repetitions the child appeared confused and refused to pick up any object or picked up the wrong object, he was given another test with a plate slightly lower in the scale—e g., Plate 31 or 29 This was always introduced with a new object If the child still failed to make a response after attentively gazing at the group, or if he made an incorrect choice, another plate of a still lower denomination was substituted and introduced with a new object On all of these occasions the child's attention was distracted or the child was led away while these changes were being made. Moreover, the positions of all of the objects in the group were changed after *every* trial

When a plate sufficiently low enough on the scale was put in the group so as to elicit the correct response, re-testing was made with changes of position in the group After several of such repetitions we then substituted plates higher in the scale, if the child's choice was consistently correct If the child's motivation did not fade this was continued until he responded correctly to Plate 32

Sometimes, the first few trials were made with Plate 1 and on other occasions with Plate 32, or any of the higher plates This

was done either to check on the child's knowledge of Plate 1 or to avoid the constant appearance of any one higher plate becoming a visual cue.

In all of the first three tests (given on different test periods) one trial would be in one room and the next trial in another with the "stage set" before the child entered. After the first three trials the groups were made up in the same room, while the child's attention was distracted.

e. Additional material. In addition to the plates we included a flat "L" shaped object[1] and a pictureless picture frame—both are described in the mechanical drawing. We shall explain more about these later.

f. Interest in the test material itself. None of the children showed any particular liking for the plates as evidenced by the length of time it required to teach them the symbol for Plate 1. To be safe, however, in most cases the children were shown some of the other plates 10 or 15 minutes before the tests began, that they might tire of them completely. In other words, they were in with their other toys when the test period first started.

g. No rewards were given for correct responses. In most instances the children were mildly praised when they made the correct response, e.g., *"smart boy—good work."* Nothing was said when they made the wrong response. In a few instances where the associations were badly broken down, the child was reconditioned. Statements are made of these reconditionings in the reports of the tests.

h. Symbols other than that for the plate were given during the tests, e.g., the child would be asked for the ball or the clock in the group. Moreover, the child was sometimes asked for the plate when it was not present, or given the command *"thank you,"* which our children all understood to mean "give me something or give 'it' to me." Each instance of these symbols is reported. The purpose of thus confusing the child was to determine the strength of the association built up in the child's mind between the symbol *"ate"* and any of the plates. This procedure was suggested by my assistant, Mrs. Virginia Seeleman.

i. Inter-test conditioning. Between many of the tests rather

[1]A suggestion of Dr. Martin Scheerer of Montefiore Hospital, New York City.

long intervals elapsed Hence, we reconditioned the children to assure the maintenance of the associations between *"ate"* and Plate 1 In the reports this is called "inter-test conditioning"

3 Scoring

(1) The trials varied in number for each test so that no accurate comparison can be made of the scores—e g, some tests had 20 trials and others only five or six The rough scores that we gave are simply for the purpose of showing in a specific test how far the child's judgment is removed from chance (where the choice involves the correct discrimination between at least four or five objects)

(2). Mistakes made in the identification of objects other than the plates, the *"L"* or the picture frame are not counted

(3). Trials with symbols such as *"thank you"* were not counted

(4) Trials where the child was asked for the plate when none was present were not counted, since our children at this period could be thus confused in connection with any of the words they used

(5) Trials were counted where the child picked up the plate when another object was asked for

(6). Trials where the child picked up the plate *before* the symbol was given were not counted.

On account of the great number of variable factors in each test, it is impossible for us to make any general tabulation We are therefore obliged to give individual reports of each test for each subject

In these reports the following data will be given: the ages, the intelligence quotients, the number of conditionings before the tests, the number of tests and the trials per test; the materials for each test and trial; the responses, the concomitant factors and the test scores, as well as special comments

In the response column the symbol "+" means a correct response and the symbol "—" means an incorrect response—e g, *"Plate 1, +,"* means that the symbol *"ate"* was given and the child picked up Plate 1 *"Clock —"* means that the child was given the symbol for clock and picked up the wrong object

TABLE 1
CONDITIONING PERIOD

Age	Number of times "*ate*" was continuously repeated
18.22	100
18.24	100
18.26	91
18.29	100
19.01	44
19.06	73
19.08	22
19.10	10
	540 conditionings on 6 test periods

TABLE 2
TEST 1, AGE—19.10
Objects in the group on the first trial a red box 2½ x 2½ x 5½ inches, a flashlight, nickleplated, a grey rubber cat approximately 8 inches high

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	Plate 1	+	
3	Plate 1	+	
4	Plate 25	—	Introduced with a blue package of mouth swabs perceptible through cellophane Picked up Plate 25 immediately after the package
5	Flashlight	+	
6	Plate 25	+	(Package replaced by rubber dog Test given in another room)
8	Plate 25	+	Went into a tantrum at this point and the test had to be discontinued
		Score—83%	

C The Individual Reports of the Tests

1 *Subject 1 Sex—Girl, IQ—110*

Comments on Table 3 Note that she failed on Plates 32 and 29 in the beginning but later by the association of similarity to Plate 23, identified Plate 25 and by further association between Plates 25 and 29 succeeded in identifying Plate 32.

TABLE 3

Test 2, Age—19 22

Inter-test conditioning—None

Objects in the group on the first trial White box 2½ x 2½ x 5½ inches; red ball, diameter 6 inches, round, red rattle

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	+	
3	1	+	
4	32	—	Introduced with small white dog
5	29	—	
6	23	+	
7	23	—	
8	23	+	
9	25	+	Introduced with small bottle
10	25	+	
11	29	+	Introduced with a sponge
12	29	+	
13	29	+	
14	32	+	Introduced with a red box 6½ x 6½ x 7½
15	32	+	
		Score—80%	

Comments on Table 4 In this test the span of generalization from Plate 1 to 32 had begun to show signs of becoming set.

Comments on Table 5 As will be found in all of these tests, any trick or manner of confusing the symbols tends to weaken or destroy the verbal association established. Trial 4, however, was counted as a failure

TABLE 4

Test 3, Age—20 06

Inter-test conditioning—43 on 3 test periods

Objects in the group on the first trial, The red ball (as above), a triangular block, plain wood, inch thick, 2 inches wide at base, a yellow box 2½ x 2½ x 5¼

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	
2	1	+	Introduced with rattle
3	32	+	Introduced with rubber heel
4	1	+	Lost interest after this trial
		Score—100%	

Comments on Table 6 It is significant that she picked up Plate 32 three times in succession *before* the above recorded trials were given. She picked up this plate the moment that she saw the group of objects and without waiting for the symbol *"ate"* Thus, the

TABLE 5

Test 4, Age—20.22

Inter-test conditioning—89 on 5 test periods

Objects in the group on the first trial A white box 4 x 4 x 6 inches, an unpainted square block 2 x 2 x 1 inches, a rubber cat, grey, 8 inches long

Trials	Objects	Response	Concomitant factors
1			The symbol "thank you" was given while Plate 32 was in the group Handed the experimenter the box (the nearest object at hand)
2	Plate 1	+	Symbol *"ate"* given after the plate was introduced with a bottle
3	1	+	As usual the plate was in a different position
4	No plate present		The symbol *"ate"* was given and she handed me the box after a moment of hesitation
5	Plate 32	+	
6	32	+	
7	32	+	
8	32	+	
		Score—85%	

TABLE 6

Test 5, Age—20.24

Inter-test conditioning—None

Objects in the group on the first trial A red rattle, a wooden cylinder 8 inches long, a white box that was used in Test 4

Trials	Objects	Response	Concomitant factors
1	Plate 32	—	
2	27	+	
3	27	—	
4	Rattle	+	
5	Plate 1	+	Introduced with a grey rubber cat
6	1	+	
7	1	+	
8	1	—	
9	1	+	
10	1	+	
11	Box	—	
12	Plate 1	+	
13	1	—	
14	1	+	
15	1	—	
		Score—61%	

situation rather than the *word itself* produced the response Test 5 followed two days after Test 4. The shortness of the interval

might explain the child's response to the situation. We tried to keep later tests at least 14 days apart. During the intervals, we gave the children a number of tests for other stimulus objects in groups so as to determine the strength of additional verbal associations.

Note that the first trial is recorded as a failure. The child was

TABLE 7

TEST 6, AGE—21 06

Inter-test conditioning 50 on 2 test periods

Objects in the group on the first trial: A blue box 2½ x 2½ x 5¼, a bottle about 4 inches long, an unpainted wooden cylinder, 6 inches long, diameter 1 inch, the *"L"* described in the drawing, a clock, blue—diameter 5 inches

Trials	Objects	Response	Concomitant factors
1	No plate present		The *"L"* right side up. Picked it up when the symbol *"ate"* was given
2	A clock	+	
3	No plate present		The symbol *"ate"* given. Picked up the *"L"* which was upside down in a different position
4	No plate present		The same as in Trial 3 except the *"L"* was right side up
5	No plate present		The symbol *"ate"* was given and the cylinder was picked up.
6	No plate present		The same as Trial 5 except the box was picked up
7	No plate present		The same as Trial 3. Trials 5, 6, 7 counted as failures
8	Plate 32	+	Symbol *"ate"* given and the *"L"* removed
9	32	+	
10	32	+	
11	The *"L"*	—	The plate was removed and symbol *"ate"* given. Picked up the triangle. The *"L"* was upside down
12	Plate 1	+	
13	1	+	
14	1	—	
15	12 (green)	—	Introduced with a bottle about 2 inches long
16	The box	+	
17	Plate 12 (green)	—	
18	12 (red)	+	
19	12 (green)	+	
20	The clock	+	
21	Plate 12 (green)	+	
22	27 (unpainted)	+	

Score—75%

accustomed to being praised when successful When she was not, as in this instance, she may have become discouraged or confused.

Comments on Table 7 (*a*) Precautions were taken in the first two trials to avoid what happened in Test 5 where the child picked up the plate from the cue of the general situation before the symbol Hence, we gave her the symbol for an object that was not a plate.

In Trials 3 and 4 she generalized to the extent of including the "*L*"—of picking up the "*L*" when given the symbol "*ate*" This did not happen on the 5th and 6th trials It might have been because of our not having praised her in Trials 3 and 4 The long part of the "*L*" had the same width and thickness as Plate 28 and was only 4¾ inches shorter. Here is an instance of the generalization span extending from Plate 32—15¾ x ¼ inches—to the "*L*" The explanation may be that the child centered her attention on the long part of the "*L*" while the rest of this figure blended into the background

(*b*). That the former associations were still alive is manifested by the fact that when Plate 32 replaced the "*L*" she picked it up in two trials She also made correct responses during the next two trials when Plate 1 replaced Plate 32.

(*c*) Her failures in Trials 14, 15, 16 might be explained by the fact that her attention and interest at this period were extremely weak

(*d*) The red color of Plate 12 in Trial 17 might explain the re-establishment of the correct association in this trial, despite the fact that her attention was still very poor

TABLE 8

TEST 7, AGE—21 12

Inter-test conditioning—None

Objects in the group on the first trial All of them were unpainted as is Plate 32 which was used in this trial—a cylinder 8 inches long, a box 6 x 4 x 2 inches, a triangle (base 2 inches)

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	
2	32	+	
3	1	+	Placed in new group with red
4	1	+	objects the same color as Plates
5	1	+	1 and 11—a ball, box, poker
6	11	+	chip
7	11	+	
		Score—100%	

Comments on Table 9 It is to be noted that she did not once pick up the screwdriver when the symbol *"ate"* was given, which slightly resembled the 32nd plate

TABLE 9
Test 8, Age—22 04
Inter-test conditioning—90 on 1 test period
Objects in the group on the first trial Brown toy dog, white box 2½ x 2½ x 5½, red handled screwdriver

Trials	Objects	Response	Concomitant factors
1	Plate 32		Picked it up before being given the symbol Not counted in score
2	32		The symbol "thank you" given Picked up the plate
3	32		The same symbol given She became confused and refused to make a choice
4	32	+	The symbol *"ate"* was given.
5	32		The symbol *"Thank you"* given Picked up the box
6	32	+	The symbol *"ate"* given
7	1	+	The symbol *"ate"* given Introduced with grey rubber cat
8	1		Poor attention—no response
		Score—100%	

Comments on Table 10 It is hard to say that this choice of the frame was not induced by the child's interest in the frame alone She was given no praise when she chose the frame which possibly might have explained the change of choice in Trials 7 and 8 to the box The frame as a whole resembled the square Plate 1 more than Plate 32, still the four sides individually resembled Plate 32 more than they did Plate 1 In these particular trials, what was the ground and what was the form? Before attempting to answer this question one would have to be certain that the verbal association was intact and that the child was giving full attention Moreover, one would have to make certain that she was not being influenced by a special preference for picking up one object or the other, irrespective of its possible association with the correct symbol There was no means of our furnishing this data

2 *Subject 2*

Comments on Table 12 There is a vague suggestion that the first *nonconditioned* span of generalization, as manifested in the early trials, was from Plate 1 to 27, but on the faint evidence we have,

TABLE 10

TEST 9, AGE—22:27

Inter-test conditioning—None

Objects in the group on the first trial A red box $2\frac{1}{2} \times 2\frac{1}{2} \times 5\frac{1}{4}$, the dark gold picture frame described in the drawing; the cylinder unpainted 8 inches

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	Note, with the frame
2	32	+	
3	32	+	
4	Box	+	
5	Plate 1		Introduced with ball (red) She picked up the frame Not counted incorrect
6	1	—	Chose the box
7	1	—	Chose the box
8	7	—	Chose the box
9	1	+	
10	1		Chose the frame
11	1		Chose the frame
12	1	+	
13	1		Chose the frame
14	1		Chose the frame
15	1		Chose the frame
		Score—62%	

TABLE 11

CONDITIONING PERIOD

Age	Number of times "ate" was continuously repeated
20:12	54
20:14	107
20:17	70
20:19	75
20:21	101
20:23	105
20:26	30
	542 conditionings on 7 test periods

some might say that this span was from Plates 1 to 32 This span, however, may have been stretched in virtue of the child's experience with Plate 27 We prefer to regard the shorter span as being the initial unconditional generalization

TABLE 12

TEST 1, AGE—20 26

Objects in the group on the first trial A grey rubber cat, a flashlight 4" long—nickel, a red box 2½ x 2½ x 5¼

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	+	
3	No plate present		The symbol "*ate*" given Picked up the box
4	Plate 27	+	(Introduced with an unpainted triangle—base 2 inches)
5	Flashlight	+	
6	Plate 32	+	Introduced with a red ball
7	1	—	Picked up the box
8	27	+	Introduced with a sponge
9	1	+	Not introduced with another object
10	1	+	
11	1	+	
12	1		Symbol "*thank you*" given Picked up the ball
13	Plate 1	—	
14	1	+	
		Score—75%	

TABLE 13

TEST 2, AGE—21 01

Inter-test conditioning—110 on 1 test period

Objects in the group on the first trial The clock, a red rattle, and the red box

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	The symbol "thank you" given
2	32		Picked up Plate 32, but given no credit
3	32	+	
4	Clock	+	
5	No Plate present		Picked up the ball
			The symbol "*ate*" was given
6	Plate 32	—	Picked up the ball
7	32	—	Picked up the box
8	32	—	Picked up the ball
9	32	—	Picked up the clock
10	No plate present		The symbol "*ate*" given Picked up the box
11	Plate 32	—	
12	32	+	Picked up the box
13	1	—	
14	1	—	
		Score—27%	

Comments on Table 13 The confusion trials in this the 2nd test were perhaps premature and may explain the large percentage of failures

TABLE 14

Test 3, Age—21 15

Inter-test conditioning—102 on 2 test periods

Objects in the group on the first trial The red ball and box and triangle

Trials	Objects	Response	Concomitant factors
1	Ball	+	
2	Plate 32	+	
3	32	—	Picked up the box
4	32	+	
5	32	+	
6	The *"L"*	—	No plate in the group The *"L"* right side up The symbol *"ate"* given and he picked up the box
7	The *"L"*	—	The symbol *"ate"* given and he picked up the ball Not counted
8	Plate 1	—	The *"L"* removed. Picked up the box
9	1	+	
10	1	—	Picked up the box
11	1	—	Picked up the box
	Conditioning		The experimenter pointed to Plate 1 and said *"ate"* once
12	Plate 1	+	Special care taken in changing the position of the plate in the group when he was not looking
13	1	+	Last 3 trials not counted
14	1	+	
		Score—55%	

Comments on Table 14 Note that in this test the child did not include the *"L"* in the generalization span.

TABLE 15

Test 4, Age—22·04

Inter-test conditioning—None

Objects in the group on the first trial The flashlight, the box of swabs, a red rattle

Trials	Objects	Response	Concomitant factors
1	Flashlight	+	
2	Plate 32	+	
3	32	+	
4	1	+	Introduced with the red ball
5	1	+	Lost interest after this trial
		Score—55%	

Comments on Table 16 Subject 2 did not include the frame in his span of generalization, even when Plate 1 was substituted for Plate 32 A comparison with his behavior and that of Subject 1 under the same circumstances is interesting

TABLE 16

TEST 5, AGE—22 08

Inter-test conditioning—None

The objects in the group on the first trial The red ball, the rubber cat and the frame (see the mechanical drawing)

Trials	Objects	Response	Concomitant factors
1	Plate 31	+	Chose the plate rather than the frame
2	31	+	Chose the plate rather than the frame
3	31	+	Chose the plate rather than the frame
4	1	+	Chose the plate rather than the frame
5	1	+	Chose the plate rather than the frame
6	1	+	Chose the plate rather than the frame
		Score—100%	

TABLE 17

TEST 6, AGE—25 04

Inter-test conditioning

Objects in the group on the first trial A large sponge, the triangle, a white box 2½ x 2½ x 5¼, the red ball

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	+	
3	1	—	
4	1	+	
5	Ball	+	
6	Plate 1	+	
7	Ball	+	
8	Plate 1	+	
9	32	+	Introduced with a 1 inch bottle and a large yellow flower
10	32	+	
11	Box	—	
12	Plate 32	+	
13	32	+	
14	1	—	Introduced with a glass fruit jar He chose the jar
15	1	+	
		Score—83%	

3. *Subject 3*

TABLE 18

CONDITIONING PERIOD

Age	Number of times "*ate*" was continuously repeated
20:04	100
20:06	100
20:08	91
20:11	100
20:13	73
20:15	22
20:18	12
	498 conditionings on seven test periods

Comments on Table 19. There is the suggestion of the first unconditioned generalization span being from Plate 1 to Plate 25. In this same test, however, as in other cases, the span seems to widen as far as Plate 32.

TABLE 19

TEST 1, AGE—20:20

Objects in the group on the first trial: The red ball, the rattle, the white box

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	+	
3	1	+	
4	Ball	+	
5	Plate 25	+	Introduced with the triangle
6	25	+	
7	29	—	Introduced with the flashlight. Chose rattle
8	29	+	
9	29	—	Chose the flashlight.
10	32	+	Introduced alone
11	32	+	
		Score—80%	

Comments on Table 21. Here again, we find the correct association broken down by giving the child the symbol when the object to which it had been associated with in his mind was absent. The symbol "Thank you" did not confuse this child as much as it did some of the others.

Comments on Table 22. In Trials 5 and 7 he chose the block

TABLE 20

TEST 2, AGE—20 24

Inter-test conditioning—None

Objects in the groups on the first trial A yellow box 2½ x 2½ x 5¼, the unpainted wooden cylinder, the rubber cat—gray

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	
2	1	+	
3	32	+	Introduced with the red ball
4	1	+	
5	32	—	He chose the cylinder
6	Plate 30	+	
7	32	+	
		Score—85%	

TABLE 21

TEST 3, AGE—21 22

Inter-test conditioning—16 on the test period before the testing day. Objects in the group on the first trial: The white box, red ball, flashlight, square block 2 x 2 x 1 inches

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	
2	No plate present		The symbol *"ate"* given Chose the block after several moments hesitation while looking over the objects
3	Plate 32	—	Chose the box
4	32		The symbol *"Thank you"* given Chose the plate
5	32	+	The symbol *"ate"* given
6	32	—	Chose the block
7	32	+	
8	Ball	+	
9	Plate 1	+	Introduced alone
10	1	+	
11	1		The symbol *"Thank you"* given Chose the plate.
12	1	+	The symbol *"ate"* given
13	1	+	
		Score—88%	

when the symbol *"ate"* was given with no plate present This block being square had the same proportions as the first plate. Certainly, this choice was an intelligent act However, rather than giving him credit we did not count these trials in scoring He was credited with failure on Trial 13.

TABLE 22

TEST 4, AGE—21 24

Inter-test conditioning—None

Objects in the group on the first trial A small mouth organ—nickle, the clock, the square block, the red box 2½ x 2½ x 5¼

Trials	Objects	Response	Concomitant factors
1	Clock	+	
2	Plate 1	+	
3	1	+	
4	32	+	Introduced with a sponge
5	No plate present		The symbol "ate" given Chose the block
6	Plate 32	+	
7	No plate present		Chose the block
8	Plate 32	+	
9	32	+	
10	No plate present		Refused to make a choice
11	Plate 32	+	
12	32	+	The symbol "thank you" given Chose the plate
13	32	—	Chose the block
14	32	+	Chose the block
		Score—90%	

TABLE 23

TEST 5, AGE—22 01

Inter-test conditioning—102 on 2 test periods.

Objects in the group on the first trial The mouth organ, the ball and white box as well as the "L"

Trials	Objects	Response	Concomitant factors
1	The "L"	+	Right side up and no plate present
2	The "L"	+	
3	The "L"	+	
4	Box	—	He chose the ball
5	Plate 32	—	
6	32	+	
7	32	+	
8	32	+	
9	1	+	Introduced with gray rubber cat
10	1	—	He chose the mouth organ
11	1	+	
12	1	+	
13	1	+	
14	12 (Green)	+	
15	12 (Green)	+	
16	12 (Green)	+	
17	12 (Green)	+	The symbol "thank you" given Chose the plate
18	No plate present		The symbol "ate" given Chose the box
19	Plate 12 (Green)	+	
20	12 (Green)	+	
		Score—90%	

Comments on Table 23 Whereas Subject 2 did not include the "*L*" in his generalization span, both Subject 1 and this subject did This is particularly obvious in the above test

TABLE 24

Test 6, Age—21 07

Inter-test conditioning—None

Objects in the group on the first trial—The clock, the red box and the triangle, as well as the "*L*"

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	
2	32	+	
3	Clock	—	
4	The "*L*"	+	No plate present
5	Plate 1	+	Introduced alone
6	1	+	
7	11	+	Color—green
		Score—100%	

TABLE 25

Test 7, Age—21 23

Inter-test conditioning—12 on the test period that preceded the test

Objects in the group on the first trial The white box, cylinder and gray cat

Trials	Objects	Response	Concomitant factors
1	Plate 32		Picked up the plate before the symbol was given Not counted
2	32		The nonsense syllable "*Tavid*" given Picked up the box Not counted in the score
3	32	+	The symbol "*ate*" was given Dropped the box and picked up the plate
4	32		The symbol "thank you" was given Chose the plate Not counted on the score
5	32	+	The symbol "*a'e*" given
6	32		The symbol "*thank you*" given Chose the box
7	32	+	
8	8	+	Introduced with red ball
9	8	+	
10	8	+	
		Score—100%	

Comments on Table 27 Only in Trial 3 did the child choose the frame instead of Plate 1 when the symbol was given Here again, the problem of what is the ground and what is the form arises

TABLE 26

TEST 8, AGE—22.00

Inter-test conditioning—None

Objects in the group on the first trial: The clock, the triangle and the red ball

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	Choice made without *any* symbol No credit.
2	32	+	Choice made without *any* symbol No credit.
3	32	+	Choice made without *any* symbol No credit.
4	32	+	Choice made without *any* symbol No credit
5	1	+	Choice made without *any* symbol No credit
6	1	+	Plate 1 hidden in a corner He had to search for it He did not begin to search until the symbol *"ate"* was given
7	Clock	+	Plate 1 in the group.
8	Triangle	—	Plate 1 in the group. Chose the ball
9	Plate 1	+	
10	Clock	+	Plate 1 in the group
11	Triangle	—	Plate 1 in the group
12	Plate 1	+	
		Score—100%	

TABLE 27

TEST 9, AGE—22 16

Inter-test conditioning—42 on preceding test period

Objects in the group on the first trial The gray cat, the red box, the cylinder

Trials	Objects	Response	Concomitant factors
1	Plate 32	+	
2	32	+	
3	1	—	Introduced with the frame. Chose the frame
4	1	+	With the frame present
5	1	+	With the frame present.
6	32	+	With the frame present
7	1	+	With the frame present
8	1	+	With the frame present
		Score—87%	

4 *Subject 4*

Comments on Table 29 Here the first unconditioned generalization span seems to be from Plate 1 to Plate 12. This would make her span (nonconditioned) about one-half that of the other subjects If this is so, we have no explanation to offer

TABLE 28

CONDITIONING PERIOD

Begun at age—21 03	Ended at age—22 28 involving 597 conditionings on 16 test periods

TABLE 29

TEST 1, AGE—23 28

Objects in the group on the first trial The rattle, the red box and a man size black rubber heel

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	+	
3	1	+	
4	29	+	We neglected to introduce it with another object The stick seemed to attract her attention On the next trial she failed
5	29	—	
6	24	—	
7	4	+	
8	18	—	
9	12	+	Color—Green
10	12	+	Color—Green
Score—General—70%—For trials on Plate 1 to 12—100%			

TABLE 30

TEST 2, AGE—24 05

Inter-test conditioning—79 on two test periods

Objects in the group on the first trial The red box and ball and rubber heel

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	—	
3	1	+	Chose the red box
4	1	+	
5	1	+	
6	Ball	+	
7	Plate24	+	Color—Yellow—introduced with mouth organ
8	24	+	
9	24	+	
10	32	+	Introduced alone
11	32	+	
12	32	+	
		Score—90%	

Since Subject 4, in all the other tests, was somewhat uncooperative, we rewarded her with candy, when she scored correctly

Comments on Table 30 Here the span spread to the fullest extent of our scale

TABLE 31

Test 3, Age—24 08

Inter-test conditioning—None

Objects in the group—The white box, the red ball, the rubber cat

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	—	Chose the white box
3	1	—	Chose the red ball.
	Reconditioned to Plate 1—15 times		
4	1	+	
5	1	+	
6	1	+	
7	24	+	Introduced with the screwdriver
8	24	+	
9	24	+	
10	24	+	
11	32	+	Introduced with the mouth organ
12	32	+	Introduced with the mouth organ.
		Score—83%	

TABLE 32

Test 4, Age—24 12

Inter-test conditioning—15 conditionings on 1 test period

Objects in the group on the first trial The red ball, the rubber cat, a toy white dog 1½ inches long

Trials	Objects	Response	Concomitant factors
1	Ball	+	
2	Plate 1	+	
3	Ball	+	
4	Plate 1	—	Chose the dog
5	Ball	—	
6	Plate 1	—	Chose the ball
	Reconditioned to Plate 1—20 times		
7	Plate 1	+	
8	1	+	
9	Ball	—	
10	Ball	—	
11	Ball	—	
12	Ball	—	
13	Chair	+	
14	Plate 31	+	
		Score—66%	

Comments on Table 32. Note that in every one of the five trials, which involved the rattle, the child made an incorrect choice. Here

TABLE 33

TEST 5, AGE—24 16

Inter-test conditioning—17 on the test period preceding

Objects in the group on the first trial The square wooden block, the gray cat, the red rattle

Trials	Objects	Response	Concomitant factors
1	Plate 1	+	
2	1	+	
3	1	—	Picked up the rattle
4	1	+	
5	1	+	
6	1	+	
7	Rattle	—	Gave Plate 32 which had been substituted for Plate 1
8	Rattle	—	Gave the cat
9	Plate 32	—	Gave the block
10	Rattle	—	Gave the 1st plate, substituted for Plate 32 Counted incorrect in the scoring
11	Rattle	—	Gave the cat
12	Plate 1	+	
13	Rattle	—	Gave the cat
14	Plate 1	—	Gave the rattle
15	24	+	
		Score—70%	

TABLE 34

TEST 6, AGE—24 19

Inter-test conditioning—None

Objects in the group on the first trial The red ball, the white box, the rubber heel

Trials	Objects	Response	Concomitant factors
1	Ball	—	
2	Plate 1	+	
3	1	+	
4	Ball	+	
5	Plate 1	+	
6	32	+	Introduced alone
7	32	+	
8	32	+	
9	Ball	+	
10	Plate 28	—	Color—Green She picked up the heel
11	28	+	
		Score—87%	

is an excellent example how a child may react in a multiple choice test of this sort when no association exists between the symbol and the correct object.

TABLE 35

THE SCORES OF THE GENERALIZATION TESTS

Number	Subject 1	Subject 2	Subject 3	Subject 4
1	83	* 75	80	70
2	80	* 25	85	90
3	100	* 55	88	83
4	85	100	90	66?
5	61	100	90	70
6	75	83	100	87
7	100		100	
8	100		100	
9	62		87	
Average	73 4	73	91 1	77 7

*Low scores due to premature confusion trials

D. SUMMARY AND GENERAL COMMENTS

The object of this study was to observe the generalization span of four children below the two-year age level The materials used were a series of plywood plates—32 in number—which varied in form and size from the lowest, 8 x 8 inches, to the highest 15¾ x ¼ inches. The differential between all of these plates was an increase of ¼ inch in one dimension and a decrease of ¼ inch in the other. A frame and a cardboard *"L"* were also used (Figure 1)

1. While it took over 500 repetitions during a period of many weeks to build up a significant association in the minds of the children between the symbol *"ate"* and the vision of Plate 1, we discovered that this same association *without further conditioning* included plates high up in the scale On the first trial Subject 1's span ranged from a plate 8 x 8 inches (Plate 1) to a plate of a different color 14 x 2 inches (Plate 25). Subject 2's span, on the first trial was from a plate 8 x 8 (Plate 1) to one 14½ x 1½ inches (Plate 27), that of Subject 3's span was the same as that of Subject 1. Subject 4's span, on the first trial, did not extend beyond the range of from a plate 8 x 8 inches (Plate 1) to one 10½ x 5¼ inches (Plate 12).

The *first* span of generalization in the first tests of Subjects 1, 2, and 3 might have been wider if we had jumped immediately from

Plate 1, in these instances, to plates higher than Nos 25 and 27 This was a mistake on our part which we avoided in the case of Subject 4 In these same tests most of the first three subjects extended their generalization span to Plate 32, but only *after* having made a narrower span first

2 Two of the children were given nine tests and two were given six tests over a period of many weeks The total number of trials for all of these tests was 352 Throughout these tests the same span of generalization was maintained Once these children had spread their generalization from Plate 1 to Plate 25—8 x 8 inches to 14 x 2 inches, or thereabouts—it required only two or three trials at the most for them to extend the span up to the last plate, which was 15¾ x ¼ inches This all of them did by the end of the second tests Having generalized, for example, so as to include Plates 1 and 25, it was an easy matter for them to generalize still further, namely, from Plate 25 to 32, resulting in a total span of from 1 to 32 The rapidity of the conditioning involved in this spread of the generalization span cannot be explained in terms of sudden acceleration of maturation or a marked increase in the ability to form associations, for even at the time that these tests were being completed all of our subjects, as our records show, required several hundred conditionings over a period of from 10 to 14 days before they showed any signs of having added any new words to their subvocal vocabularies

3 There was no evidence that the generalization tests could be used as an accurate gauge of a child's initial generalization span nor that there was any correlation between this phenomena and the child's general intelligence.

4 The generalizations made in these tests seemed to be based on similarity of *form* rather than on *color*, even in cases where the shades of the plates and those of other objects in the group were almost the same and the shapes of the plates, included in the generalizations, were very remotely similar—see, in particular, Test 7 of Subject 1 This is in strict agreement with the results of Brian and Goodenough's experiments on the relative potency of color and form perception of children below the age of 24 months (1) Of course, the generalizations of our children were not based on pure form but on the combined characteristics of form and area The calibration of the form of the plates necessitated the graduated diminution of their areas.

5 In some cases the children not only generalized from Plates 1 to 32, but included in their span of generalization a cardboard "*L*" and a picture frame. Though the long part of the "*L*" was of the same width and thickness as Plate 28 and almost as long, it might have been expected that its bottom would so change the total configuration that the child would fail to associate it with the symbol for "plate." If the generalization span of children at this age can extend this far, when but one or two qualities are essentially involved—form and size—it might be possible for the span to extend still further for such children when essential qualities greater in number are present.

6 The tests showed that below the two-year age level it was extremely easy to destroy verbal associations by giving the children symbols for objects not present

In a subsequent paper we shall publish data showing the success that these same subjects and 20 others had in discriminating these same plates Two of the children used in the present tests were able to distinguish the 8" x 8" plate from the 8¾" x 7¼" plate. One distinguished the 8" x 8" from the 8½" x 7½" plate about the time the generalization tests were being completed

In another paper we shall publish figures showing the changes that take place in the generalization span in the process of mental development by comparing the results of tests with children at the age levels of 24, 36, and 48 months.

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The Journal of Genetic Psychology, 1939, 55, 299-318

ABILITIES OF INFANTS DURING THE FIRST EIGHTEEN MONTHS*

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A variety of evidence from many points of view has been adduced to describe and explain the emergence of behavior during infancy. Developmental problems have been a major interest in Gesell's work for a number of years, and more recently Halverson (8), Shirley (17), and others have produced much significant material in this field. Basic to the quantitative estimation of patterns of behavior is the creation of tests, a task to which Gesell early devoted himself. Attempts to standardize Gesell's baby test situations or situations like them have been made by several investigators (2, 3, 4, 12, 14, 15).

We know of no attempt so far to analyse the results of baby test material by means of factor analysis; it is the purpose of this paper to present such analysis of test results secured from children at 6, 12, and 18 months. The Gesell tests were used at each age level, in the manner described by Gesell (7). Earlier papers (14, 15) have described the test results in detail; this study will be limited to the correlational and analytic procedures, results, and interpretation.

Eighty infants were used at each age level; about 40 per cent of the infants were included in each group, so that the study is longitudinal in certain respects. Sexes were distributed about evenly. Children were tested within four days of the six months birthday, five days of the one year birthday, and seven days of the eighteen months birthday.

The split half reliabilities of the total tests at each age level were obtained by using items alternating in difficulty. For these correlations all items were used (not only those used in the factor analyses). The corrected coefficients were as follows: 6 months .89, 12 months .84, 18 months .79.

*Received in the Editorial Office on September 26, 1938.

The total test scores intercorrelated as follows: six with twelve months, .72; six with eighteen months, .42; twelve with eighteen months, .56.

Item Intercorrelations

For the intercorrelations all tests were used at each age level which were passed by at least 25 and not more than 75 per cent of children and which were not contingent upon one another. (For example, since all children who walk can stand, standing was rejected and walking retained at twelve months.) This selection of items perhaps eliminated several which may be considered as particularly diagnostic, and the rejection of which may leave the schedule a different instrument than Gesell described. To our observation, however, the items in the middle 50 per cent are reasonably representative of the area tested by the total schedule at each level.

Tetrachoric coefficients were used throughout. On a group of 80 children, the tetrachoric coefficient has a standard error of from .00 to .22, depending on its size and the degree to which the two variables split the group evenly. The modal standard error at .17 indicates that a coefficient had to be .50 or better to be very significant of interrelationship.

Two types of factor analysis were used, the method of multiple factors, for which Thurstone's accounts (20, 21) were used as guides, and the bi-factor method of Spearman and Holzinger for which Holzinger's accounts were used (9, 10).

The intercorrelations at each age level appear in Tables 1, 2, and 3. We shall not pause to examine the coefficients at this point more than to point out the interesting fact that intercorrelations are greatest for the six months group and least for the twelve. This fact merits consideration in the light of the findings of several studies which show that for a given battery of tests intercorrelation drops with increasing age (and experience). These considerations will be treated in the discussion.

Multiple Factor Analysis

Two criteria were used in the multiple factor analyses to indicate when to halt the extraction of factors, the sigma of residuals criterion suggested earlier by Thurstone, and the criterion recently proposed

TABLE 1

CORRELATION MATRIX, SIX MONTHS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Splashes in tub		30	15	25	21	17	28	29	30	30	14	04	53	06	12	30	08
2	Pats table			85	59	77	69	39	31	42	03	69	66	38	67	60	80	15
3	Inhibits one hand and head				60	96	83	40	52	66	07	80	59	49	82	64	1 00	36
4	Reaches direction spoon					46	48	51	58	58	38	73	44	44	66	58	69	47
5	Manipulates hand						68	34	51	51	05	70	43	52	68	55	1 00	34
6	Makes stepping movements							40	30	62	17	57	41	31	65	42	61	20
7	Looks for fallen object								73	44	45	60	35	21	50	47	52	75
8	Throws object to floor									44	32	62	47	51	46	35	62	61
9	Takes bottle in and out mouth										56	67	21	29	44	30	40	58
10	Music stops crying											23	03	02	08	24	25	89
11	Exploratory manips												50	52	68	58	75	09
12	Bangs spoon													25	53	41	59	22
13	Regards pellet														38	46	58	23
14	Dangling ring persist reaching															69	73	48
15	Drops one cube for third																51	50
16	Secures cube																	36
17	Music laughs																	

TABLE 2
CORRELATION MATRIX, TWELVE MONTHS

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Walks alone		52	.19	22	23	05	33	19	20	28	24	.20	51	09
2	Climbs			34	45	49	19	35	05	34	30	20	15	46	15
3	Says three words				30	11	14	35	06	07	70	44	26	.18	22
4.	Tower of two					51	40	14	00	01	10	08	20	09	31
5.	Third cube						.34	36	22	.01	06	06	16	42	26
6	Inhibits hand to mouth							21	08	12	02	26	14	18	02
7	Imitates scribble								10	11	16	41	01	51	12
8	Dangling ring uses string									00	40	32	20	01	15
9	Prefers one hand										34	19	03	28	10
10	Says "Bye-bye," "hello"											31	.07	33	14
11	Points to things at table												29	32	19
12	Bowel control													16	13
13	Tries shoes														29
14.	Vocalizes to music														

TABLE 3

Correlation Matrix, Eighteen Months

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Asks for things at table		.55	62	06	34	03	20	40	72	11	.59	39	19	11	35	16
2 Two or more words together			39	.00	28	11	11	40	63	22	71	72	52	27	47	.22
3 Tower of four				08	40	40	—15	1 00	48	44	60	33	43	09	54	36
4 Cube in cup, plate					50	29	44	46	30	12	22	12	19	29	39	15
5 Formboard, circle						60	41	36	50	41	42	09	20	43	39	29
6 Formboard, shown							30	39	45	29	27	17	—16	07	09	06
7 Performance box, three square								44	57	50	57	05	11	09	46	—15
8 Points three objects in pictures									80	48	57	30	33	41	79	08
9 Names one object in pictures										57	76	41	20	33	74	00
10 Points two or more parts of body											41	30	28	17	24	01
11 Repeats things said												34	50	39	81	—07
12 Says "hello," "thank-you"													15	03	21	17
13 Listens to stories with pictures														25	44	31
14 Bladder control															73	16
15 Asks for toilet																—03
16 Uses spoon well																

(21) Sigmas of successive tables of residuals are presented in Table 4 It will be seen that, by comparison with the sigma of the original

TABLE 4
SIGMA OF ORIGINAL COEFFICIENTS, AND OF RESIDUALS IN SUCCEEDING MATRICES FOR SIX, TWELVE, AND EIGHTEEN MONTHS' GROUPS

	Six months	Twelve months	Eighteen months
Correlation	215	148	.247
1st Residual	148	143	182
2nd Residual	093	111	149
3rd Residual	083	093	138
Sigma of original coefficients	17	17	17

coefficients, the variability in the case of the six months data drops to the error point after extraction of one factor In the case of the 12 months material coefficients and successive residuals are at all points below the error limit The 18 months material permits two factors before this point

The criterion data are presented in Table 5 On the basis of this

TABLE 5
THURSTONE-TUCKER PHI CRITERION FOR SIX, TWELVE, AND EIGHTEEN MONTHS' ANALYSIS

	Six months	Twelve months	Eighteen months
Criterion	9412	9286	9375
Factor 1	5141	6768	6261
2	7857	8774	8918
3	9364	8839	9324
4		9320	

criterion, the 6 months and 18 months data evidence two factors, and 12 months data three

These conflicting results regarding the factors evidenced by multiple factor analyses of these data suggested that the factor loadings themselves should be consulted before any conclusion was made Examination of the factor loadings in each analysis and of rotated factor weights suggested that there were two factors of importance at each level. However, at 12 months, analysis has been made of three factors as well The material to follow will treat, therefore, of single factor matrices at 6 and 18 months, and of two such matrices at 12 months.

TABLE 6

FACTOR PATTERN, COMMUNALITY AND ROTATED LOADINGS, SIX MONTHS

	Unrotated			Rotated	
	$K1$	$K2$	h^2	I	II
Music Laughs	610	660	808	87	23
Music Stops crying	420	—745	731	86	
Looks for fallen object	686	—391	623	67	42
Throws object to floor	710	—267	575	57	50
Takes bottle in and out mouth	686	—267	.542	56	48
Reaches for spoon	.777	—089	612	44	64
Splashes in tub	344	—204	.160	34	
Regards pellet	568	080	.329		54
Bangs spoon	576	234	.387		62
Drops one for third cube	688	124	489		67
Stepping movements	707	228	552		73
Exploratory manipulation	820	200	712		82
Reaches for dangling ring	791	263	695		82
Pats table	775	428	784		89
Manipulates one hand	823	397	835		91
Secures cube	908	280	903		93
Inhibits head and one hand	910	440	1 022		1 00

Table 6 presents the unrotated and rotated factor loadings for the six months group.[1] The structure presented in the columns to the right, headed I and II, is quite orthogonal. The factors may be designated as an *alertness* factor and a *motor* factor. The motor factor is present in some degree in practically all tests, probably because of the obvious fact that all behavior at this early level is, in a sense, motor, at least in expression. Factor I is present most heavily in those tests which seem to imply (*a*) distance reception and (*b*) playfulness. The term alertness has been used to characterize the group.

In another study (14), it was shown that the items *regards pellet* and *splashes in tub* correlated most highly with the Stanford-Binet at three years. According to our interpretation both items would seem to possess an element of alertness. However, *regards pellet* has no alertness saturation, *splashes in tub* has no motor factor. This anomaly is exemplary of the fact that the factor characterizations

[1]In a previous report (16) these were presented, and treated as if three factors were significant. These factors were described as a *Motor* factor, an *Alertness* factor and a *general or halo effect factor*. Subsequent analysis by means of correlating the factor scores indicated that the motor and general factor were correlated .94. It is seen above, also, that the criterion suggests that there are only two factors.

TABLE 7

FACTOR PATTERN, COMMUNALITY AND ROTATED LOADINGS, TWELVE MONTHS

	Unrotated					Rotated				
				h^2		Plan 1		Plan 2		
	$K1$	$K2$	$K3$	Plan 1	Plan 2	I	II	I'	II'	III'
Says "bye-bye," "hello"	572	—471	376	549	690	73		82		
Says three words	594	—437	179	544	576	72		71		25
Points to things at table	549	—317	—056	.402	.403	60		51		38
Dangling ring; uses string	519	—337	—.274	215	.290	46		23		48
Bowel control	335	—180	—261	145	213	36				43
Walks alone	552	108	240	316	374	.28	.49	45	41	
Imitates scribble	.537	129	133	305	.323	25	49	37	42	
Vocalizes to music	363	006	—.158	132	156	.23	28		21	50
Prefers one hand	313	045	262	100	.169		26	33	22	
Inhibits hand to mouth	.373	131	—.295	156	243		37		31	38
Tower of two	486	266	—361	307	437		54		48	45
Tries to put on shoes	622	301	301	477	568		67	44	61	
Accepts third cube	548	.411	—298	469	558		68		64	.38
Climbs	660	327	209	.543	586		71	40	65	

are not nice, logical indices of system in the tests used; there are different exceptions which do not conform

The twelve months analysis, in two configurations, is presented in Table 7

Reference to the column headed h^2 will show (*a*) that the third factor adds very little to the communality over and above that contributed by the first two factors and (*b*) that the communality of the average test in the 12 months analysis, even if three factors are used, is considerably less than that of tests in the six months analysis The mean h^2 values at six months compared with those at 12 months was 633, while the later tests yielded, for two factors, .333, and for three factors, 399 Obviously, this difference is an expression of the lower correlation at 12 months, mentioned above In terms of factor theory, it is clear that the 12 months battery represents a group of tests with more specific factors than those at six—tests tending to measure more discrete functions

Plan I in the rotated system at 12 months suggests again the orthogonal arrangement demonstrated at six months Again there is a motor factor (II), and a factor composed of alertness items like *pointing to things at table, dangling ring*, etc. (though *tries to put on shoes* does not possess this factor) The two language items have the greatest saturation with the alertness factor, so that the factor may be designated as *alertness-language* Incidentally, these language items had greater predictability for later mental status than did most remaining items at 12 months (15)

Plan 2 is no aid in interpretation Factor II′ seems to be the II of Plan 1, but Factor I′ and III′ are present in a variety of tests, without apparent logic This fact plus the doubtful communality contribution would suggest that Factor III′ is an artifact,—a function of error

Table 8 presents the unrotated and rotated factor loadings of tests used in the 18 months analysis[2] Here the communality of the tests is considerably above that of tests at 12 months, at a mean of 479 compared with 333, but it is less than the mean of .633 at six months We may say that the 18 months tests have more in common with each other,—are less specific—than the tests at 12

[2]Mr James McDowell deserves thanks for the work he did on the 18 months material

TABLE 8

FACTOR PATTERN, COMMUNALITY AND ROTATED LOADINGS EIGHTEEN MONTHS

	$K1$	$K2$	h^2	I	II
Two or more words together	669	491	689	83	
Blocks. Tower of four	742	386	700	82	
Repeats things said	815	286	.746	80	32
Picture II, names one object	853	170	757	76	43
Picture Points 3 or more objects	869	090	763	71	50
Asks for toilet	786	141	638	69	41
Asks for things at table by words	586	351	467	67	
Says "hello," "Thank you"	476	.244	286	52	
Listens to stories and pictures	472	.159	248	46	
Points to 2 or more parts of body	542	—203	335	28	51
Bladder control	481	—.150	254	27	.43
Uses spoon well	220	—067	053		
Performance box square	429	—362	315		55
Formboard Shown	419	—380	320		56
Places cube in cup, plate	435	—404	352		59
Formboard circle	658	—552	738		85

months This would bear out the suggestion above, that the 18 months test covers a more restricted area than the 12 months test Either certain functions measured at 12 months have dropped out of the developmental picture, or tests for them are rejected because they are not regarded as worth sampling at 18 months

Rotated loadings at 18 months suggest again the *motor* and *alertness-language* factors There is an increased number of impure or mixed tests, however, indicating that the Gesell tests at this level tend to be more complex,—to involve mixtures of functions more than do the 12 months tests

BIFACTOR ANALYSES

Using the bifactor method of Spearman-Holzinger, factor loadings were obtained for each of the age levels as shown in Tables 9, 10, 11 Table 9 presents two sets of loadings, based on the same material Professor Karl J. Holzinger and his assistants very kindly analysed the six months material independently of us It will be seen that the results of the two independent analyses agree rather closely in most respects.

Interpretation of the six months factors on the basis of the bifactor loadings is difficult It is immediately apparent that by comparison with the multiple factor method, the Spearman-Holzinger

TABLE 9

FACTOR LOADINGS FOR TWO ANALYSIS ACCORDING TO BI-FACTOR METHOD SIX MONTHS

	Fels analysis				Holzinger analysis				
	G	(*a*)	(*b*)	(*c*)	*G*	(*a*)	(*b*)	(*c*)	(*d*)
Secures cube	81	50			85	42			
Inhibits head and one hand	77	70			75	71			
Manipulates one hand	69	58			69	57			
Pats table	64	62			63	65			
Stepping movements	58	16			58	44			
Reaches for dangling ring	72	38			69	48			
Bangs spoon	48	34			46	11			
Music Stops crying	27		91		42	—34	39		(.70)
Music Laughs	47		1 01		15		69		(.50)
Takes bottle in and out of mouth	65		28		68		50		
Looks for fallen object	66		30		61		69		
Regards pellet	55			60	56			(.59)	
Splashes in tub	30			60	33			(.59)	
Reaches for spoon	85				90				
Drops one for third cube	71				66	20			
Throws object to floor	81				74		40		
Exploratory manipulation	87				80	27			

TABLE 10

FACTOR LOADINGS ACCORDING TO BI-FACTOR METHOD TWELVE MONTHS

	G	(*a*)	(*b*)	(*c*)
Walks alone	38	44		
Climbs	45	64		
Imitates scribble	38	38		
Tries to put on shoes	47	45		
Tower of two	30	.27	56	
Third cube	28	64	46	
Inhibits hand to mouth	31		55	
Says three words	57			63
Says "bye-bye," "hello"	53			63
Dangling ring—uses string	33			
Points to things at table	65			
Bowel control	38			
Prefers one hand	30			
Vocalizes to music	40			

analysis discriminated more factors It also accounted for more variance In addition to the general factor, of which all tests have a sizeable loading at six months, the motor (*a*) and the alertness (*b*) factors seem to be present The tests possessing Factors (*c*) *regards pellet* and *splashes in tub* would be classified by us as alert-

TABLE 11

FACTOR LOADINGS ACCORDING TO BI-FACTOR METHOD EIGHTEEN MONTHS

	G	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Two or more words together	53	83						
Says "hello," "thank you"	36	43						
Asks for things at table by words	36	66						(.65)
Pictures Names one object	76	11	34					
Repeats things said	71	39	41					
Asks for toilet*	54		86*	37			(.55)	
Pictures Points three or more objects*	87			88*				
Blocks, Tower of four	71			43				(.56)
Performance box Square	16		56		58	(.56)		
Places cube in cup, plate	35				48			
Formboard Circle	63				63			
Formboard Shown	30				48			
Points two or more parts of body	55					(.74)		
Bladder control	44						(.89)	
Listens to stories with pictures	51							
Uses spoon well	22							

*Factor loadings account for more than unity variance

ness tests, but they have no Factor (*b*). However, strangely enough, these two tests rank above all other tests in correlating rather highly with later mental status (see 14) Perhaps by comparison with the unitary alertness factor shown by the Thurstone analysis, the bifactor method yields two sub-factors, one of which is characterized by tests predictive of later mental status—or to be designated as indicative of an essential core of developmental nature. Holzinger's analysis indicated the possibility of a fourth group factor, Factor (*d*), present in the two responses to music These tests possessed the alertness factor in the Thurstone analysis, but there they may characterize an auditory alertness

Table 10 presents the bifactor loadings of the tests at 12 months Here language becomes set off by the doublet (*c*), which we may call a language factor Factors (*a*) and (*b*) seem both to be motor in character, (*a*) tending toward more gross activities such as climbing, walking, etc, (though *accepts third cube* is heavily saturated) while (*b*) tends toward finer manipulations This interpretation is very tentative, however It is interesting to note that this analysis does not result in a greater number of factors at 12 months than did the six months analysis

Bifactor loadings at 18 months are presented in Table 11. Two tests at 18 months accounted for more than unity variance, *asks for toilet* and *pictures: points three or more objects*. At 18 months language characterized Factor (*a*), while Factor (*d*) is characterized by so-called "performance" tests, and may be designated as a manipulatory (or spatial) factor. Factors (*b*) and (*c*) may be some splitting up of alertness. Doublets designated as Factors (*e*), (*f*), and (*g*), are impossible of interpretation, and can probably be disregarded until more evidence is obtained with respect to them. The 18 months analysis accounts for more factors (probably) than were obtained at 12 months. This is contrary to the evidence suggested by the Thurstone analyses.

Intercorrelation of Factors

In order to determine the extent to which the factors were correlated, coefficients were calculated as follows: Each child at each age level was given the Thurstone factor weight for each of his successes. These crude factor scores were then correlated at each age level, and with like scores at each of the other age levels. An identical group of children who had received a score on each item at each age level was so small that the correlations were based on maximum groups obtainable for each level. Consequently the coefficients are based on different sub-groups throughout. They may be regarded as representing similar samplings, however.

Table 12 presents the coefficients in the upper left half of the table, and the numbers of cases for each coefficient in the lower half.

The data in Table 12 suggests that (*a*) there is a definite correlation between factor scores at each age level. This is due to the

TABLE 12

Intercorrelations between Factor Scores at Six, Twelve, and Eighteen Months (Above Diagonal) with Numbers of Cases (Below Diagonal)

	Six months		Twelve months		Eighteen months	
	Alertness	Motor	Alertness	Motor	Alertness	Motor
Six—alertness		755	371	178	277	384
Six—motor	61		286	634	—065	244
Twelve—alertness	39	39		709	448	491
Twelve—motor	39	39	77		157	239
Eighteen—alertness	36	36	51	51		826
Eighteen—motor	36	36	51	51	74	

impure nature of the tests (that is, to the fact that most of the tests at every age level possess both factors to some extent), (*b*) the six months factors predict the 12 months factors about evenly, motor tending to predict motor, alertness to predict alertness The six months factor predicts little at 18 months, however This may be due to the fact that the 18 months test is, as a whole, composed of more alertness material. Only the alertness factor at 12 months has much predictive value (*c*) At 18 months, motor performance seems to be predicted better than does alertness, but is better predicted by alertness tests

These crude data would indicate that baby test material such as that used in this study is composed of motor tests in abundance However, those tests which best predict later status are tests of less motor character. The alertness factor at six months cannot be regarded as identical with the alertness factor at 18 months, but the two are similar factors in relation to the total test at each level, the more mental elements, which later become more characteristically motor as they are replaced by more mental elements.

Discussion

The most direct approaches to the effect of age on mental organization have been made by Spearman (18), Garrett, Bryan, and Perl (6), and Anastasi (1) It is rather well shown that as age increases abilities tend to become more and more discrete Spearman has suggested that the general factor may drop in importance as children grow older Thurstone, in a recent discussion, feels that

> If it should be established that the intercorrelation of psychological tests tend to decrease with age, the effect can be interpreted in terms of a rather simple hypothesis. If we assume that the mental abilities of the young child are not clearly differentiated, he will use a wider spread of abilities in solving a problem than later when he can restrict his efforts to those mental abilities that are most appropriate for the problem This effect is readily seen in the muscular coordination of children in which larger muscle groups are involved than when the same coordination is effected by an older child or by an adult Examples are early efforts in writing, at the piano, and in typewriting. If the mental abilities become more and more differentiated with exercise and maturity, it should follow that psychological tests become less and less correlated with age (21, pp 87-88)

Where do these Gesell data fit into this study-picture of the genesis of mental organization?

Genetic data may be considered from two points of view. (*a*) We may define as equivalent sampling any two sections of behavior which use identical test situations and employ the same criteria of response. This means simply that the same tests are used for each age group. But the tests are defined as similar because a similar criterion of performance is maintained. (*b*) The second point of view would define as similar those tests at two different age levels which tended to correlate. This would imply that the underlying factors which two tests shared were of primary importance, and that the nature of the performance was secondary. Stoddard and Wellman have stated this viewpoint rather clearly:

> It is necessary to avoid the error of believing that things contributing to the same general function must themselves be alike or look alike. A task may be performed with or without verbalization, and the two acts appear grossly unlike, yet they may make essentially the same contribution to a pattern of intelligence. For example, the placing of one cube on top of the other by a child may contribute to the measurement of intelligence as adequately as the definition of *pity* fifteen years later.
>
> In measuring intelligence, we are getting at not only ingredients of the whole pattern, but at indicators, surrogates and prognosticators. We need not bother at all about the external appearance of our tests if they are shown (*a*) to be, or to be related to (*b*) to be surrogates of, or (*c*) to predict the likelihood of, *intelligent behavior as defined*. If the goal is not so much to measure intelligence as to analyze the whole behavior pattern of the child, we are of course justified in focusing our attention upon any practical aspect of development or behavior, such as motor skills, speech or ability in spatial relations (19, p. 45).

Since the Gesell items at any two age levels separated by six months are in most cases not identical tests, we cannot consider the material here presented from the first viewpoint. Hence, it is not entirely comparable material to that of Garret, *et al.*

From the second point of view, these Gesell items may be considered as indices of underlying abilities at each age level. The intercorrelations of total tests scores and of factor scores indicated

earlier in this paper suggest that the 12 months test samples $(72)^2$ or 50 per cent of the six months area, and that the 18 months test measures a smaller portion $(56)^2$ or 30 per cent

Obviously the group of tests or the area sampled by the tests may be biased in the direction of certain abilities, may measure only a small proportion of the total number of factors demonstrable at each age level, etc This possibility of uneven sampling is a serious handicap to interpretation of our data If we could assume that, despite great differences in the apparent nature of the tests used at different age levels, they covered a similar area of behavior, then our age levels would be comparable On this assumption since within the three age levels here used (6, 12, and 18 months) there was a drop in intercorrelation between test items, there was an increasing discreteness of factors from 6 to 12 months, but a decrease from 12 to 18 months (since the 18 months items intercorrelate more highly than the 12 months). At 18 months there is a drop in correlation when compared with the six months correlation, so that the 18 months level is less highly unified than the six months schedule But the 18 months series presents a greater unification than the 12 months series

Three interpretations are possible If the behavioral areas were equally sampled at each age then (*a*) the situation above might indicate that there was a differentiation of abilities from six months to 12 months indeed at 18 months there was a differentiation from six months. But between 12 months and 18 months there occurs an integration to some extent Such an interpretation would suggest that the abilities required to pass items at six months were few, and were common to a large number of tests At 12 months the abilities required are more diffuse, discrete, and possibly greater in number At 18 months there is a return to a greater unity or integration of abilities, so that fewer abilities, with greater saturation in tests are in evidence.

A second interpretation is (*b*) that the 12 months sampling is, for some reason, less adequate or even than the sampling at six months and 18 months. Thus, at 12 months we may have sampled only a portion of the core of abilities sampled at six months (and at 18 months) The drop in intercorrelation between tests from six months to 18 months suggests the differentiation principle outlined above. The exaggerated drop from six months to 12 months, and

the increase from 12 months to 18 months suggest that the 12 months sampling is inadequate for some reason, and renders that level less comparable to the other levels This interpretation suggests immediately that if the sampling at one level is regarded as inadequate, so may the others be inadequate, and it may be entirely idle to compare them in any way

Another interpretation of the drop and later rise in intercorrelation (r) is that, due to the selection of test items, consciously or otherwise, there is, during the first year, a tendency to sample a wider spread of abilities than at 18 months In later childhood there is a tendency to select items for their value as correlates with "intelligence" This selection explains the situation found by McNemar (13) to hold for the Revised Stanford-Binet McNemar found that one factor accounted for the intercorrelation of test items at almost all points Garrett and his associates, and others, selected their tests not for their tendency to correlate with such a criterion as "general intelligence," but in the hope that they would measure discrete factors, perhaps analogous to those found by Kelley (11), Thurstone (21), and others As a consequence, such studies present more of a multiple factor picture.

If we assume that the "alertness" factor we found to operate in these early Gesell schedules is comparable or identical with "intelligence," it is logical to suppose that as "intelligence" responses become with increasing age more and more observable, non-mental items are rejected to a greater extent in selecting test material At the very early age levels, most responses have a heavier non-mental saturation than later, because "intelligence" is less observable, for which there are much less adequately objective criteria of response

It is a commonplace thing that evidence for a communality of tests depends very greatly on the tests used (or sampling of abilities). Furfey, Bonham, and Sargent (5) used a group of reflex tests on newborn infants, and found little communality between tests; there was no general factor, and hence, very little evidence for an integration of these responses This result may be explained at least partly on the basis of the responses used, we believe. That is, the sampling of behavior pattern was not general, it comprised a number of discrete items If one were to regard these as a fair sampling of mentality or behavior of the newborn infant, then he should regard the result as indicating no unity at all to mental organization at that

level. But it is logical at least to consider the possibility that they do not represent an adequate sampling of mental or behavioral potentiality at that level.

Probably the correct interpretation of our material lies somewhere in the middle ground. Without an abundance of factual material upon which to base our opinion, some such interpretation as this seems possible From the behavioral point of view, it can be stated generally that the child's behavior becomes more and more "mental" as age proceeds To this extent, a total section of his behavior will seem less and less non-mental, or "motor" Thus, the selection of Gesell items to give a rough section of behavioral possibilities will include items which, defined behaviorally, or in terms of the conventional psychological categories, will be heavily motor early in life, and less heavily motor—more "mental" later, as language, problem solving, etc., appear

Conclusions

From six months on there appear to be two factors present in the mental organization of the child Whether these factors are present before this point, we do not know. The work of Furfey, Bonham, and Sargent would be considered negative (though not strong) evidence that the factors are not clearly present in the newborn infant Bayley's work would suggest that at about six months the non-motor, or alertness factor first appears

Whatever the past history of the factors prior to two months, they do possess psychological significance In general, it may be said that tests heavy in the alertness factor also correlate best with later mental status As this factor of alertness becomes more and more apparent in the total picture, it becomes incorporated as a greater and greater element in mental tests. Perhaps it is the only important factor in the Stanford-Binet at later age levels (see McNemar, 13). Perhaps it is general in psychological tests to such an extent that it is regarded as "*g*" by those adhering to the bifactor theory. In these early baby tests there is considerable evidence that non-mental functions are considered important in the sampling of behavior The abundance of these "non-mental" functions probably explains in part, the lack of correlation of later tests with later mental status But we cannot be certain that ignoring these functions would leave sufficient residue for a psychological test at all. Earlier than six months

there may be no "mental" ability of the type tested later in childhood

The bifactor analyses did not give results which agreed entirely with those of the Thurstone analyses, but the differences were not marked. On the whole the bifactor analyses discriminated more (group) factors

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The Journal of Genetic Psychology, 1939, 55, 319-352

BIRTHDAY WISHES OF FIRST GRADE CHILDREN*

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A INTRODUCTION

During the school year 1935-1936 a stenographic record[1] was made of some of the school experiences of a first grade of the Horace Mann School of Teachers College, New York City. Among other verbatim records were those of birthday wishes which the children made for one another at the mid-morning lunch hour, on the occasions of celebrations when any pupil had a birthday

It is necessary to understand the character of the school in order to interpret fairly the wishes made by the children The school is governed on the broad principle that it is a planned and guided *living* together It is, therefore, informal rather than formal. Children's natural interests, aroused and guided by the environment and the experiences provided by the teacher and the parents, are the centers of learning and development In such a setting all expressions made by the children had, it is believed, a high degree of sincerity and genuineness Naturally some of the wishes showed the suggestions of the teacher and of wishes previously made by other children In fact, the experiences of the immediate time were reflected in many of the wishes For example, the doll house activity seemed related to wishes for *a tidy house* and *doll furniture*, the seasons seemed to have inspired wishes for a *Merry Christmas, nice Christmas tree, happy birthday*, etc ; the departure of a classmate for Africa echoed in wishes to *go for a boat ride to Africa*, and the like.

Other wishes indicated recent or especially pleasurable experiences of the one wishing, for example, the oft-repeated one to *go to Fire Island*. The frequent wish that the celebrant be *healthy and wealthy* suggests the susceptibility of some of the children to the social conventions of their fortunate home circumstances It might be

*Received in the Editorial Office on September 26, 1938

[1]This material was made available through the courtesy of Miss Agnes Burke, teacher of Grade 1, Horace Mann School

proposed that the absence of mean or sordid wishes is evidence that after all the children were saying only what they knew would pass the teacher's censorship, since anyone familiar with children knows that unpleasant wishes are expressed commonly enough The explanation for their absence in this collection lies, it is believed, in the fact that the setting for the wishes ruled out, almost automatically, such statements or thoughts Whenever the wishes were made the children were seated at their lunch tables, with lunch before them or just consumed, the appropriate number of candles were lighted, and the whole situation could induce only well wishing, or at most silence by any but the most anti-social child These children were by previous description not anti-social.

The wishes were made spontaneously and although limited to brief statements, contained as many wishes as the child cared to make. As a matter of fact, 129 of the total 285 wishes were single wish statements, 51 were two, 10 three, 2 four, 2 were five, and one was a six-wish statement Two hundred and seven were first wishes, 60 were second, 12 were third, two were fourth, two were fifth, and one was a sixth wish On every occasion some children made no wishes at all This was due sometimes in part to the need for economizing time, when the teacher was forced to end the wishing before some had had opportunity to speak It was also due in part to the fact that some children could think of no suitable wish at the moment, or perhaps did not want to make a "nice" wish for the particular birthday child At any rate, none of the 285 wishes was made under duress All were, in the circumstances as briefly analyzed and described, the free thought of the children expressed in the way they naturally chose

A brief glance at the statements verifies the thought that is in the minds of all readers familiar with children the birthday wishes were fundamentally wishes for the self, rather than for the one addressed They could scarcely be otherwise. How rarely do adults achieve true self-abnegation? There are evident, however, other factors determining the wishes expressed The popularity of the receiver of the wishes probably had considerable influence It may have been that greater popularity acted as a sort of stimulus to release a greater number of wishes or more vital ones, perhaps through some such mechanism as identification: the wisher identifying himself more fully with the individuals he liked or admired the

most. The sex of the receiver usually produced appropriate wishes, and the sex of the wisher was often unmistakable in the statement. There was also a definite tendency on the part of many children to predicate their wishes on the condition, "when you grow up." No doubt, rivalry impulses, as well as imitative ones, inspired both the number, phraseology and grandiosity of some of the wishes. Other effects were probably due to other personality qualities, the particular nature of immediate school and home experiences, to the weather, digestive condition, etc.

Three presentations of the data are given. The wishes are compared with wishes of children and college women students previously published (1, 3), they are given as they were expressed in chronological order; they are re-arranged according to the pupils making them. Inasmuch as all three discussions are based upon an analysis of the wishes according to Jersild's classification of children's wishes, the comparative presentation is given first.

B. Comparison of Birthday Wishes with Wishes of College Women and Other Children

The conditions under which the data were gathered in these former two studies were somewhat different from those of the birthday wishes. In the others the wishers were asked to make wishes for themselves, the most important ones they could think of. As pointed out above, however, that is essentially what the children did in making their birthday wishes. The data for the college women were three wishes made by each. In the study of children the first of three wishes expressed by 100 5-6-year-old and 100 11-12-year-old children were used. In this report the first and also all the birthday wishes of the children are presented.

Table 1 shows the distribution of the birthday wishes in the order in which expressed, according to the classification made by Jersild and used in both the earlier studies. Two or three arbitrary rules had to be made in assigning and counting the birthday wishes, in order to make them fit the classification fairly and comparatively. One was that the double statements *healthy and strong, well and strong,* and the like, be considered as one wish and classified under Category 42, *health.* Certain other redundancies were also disregarded. *When you marry* or a similar condition of matrimony, was

TABLE 1

WISHES IN THE ORDER EXPRESSED AND ACCORDING TO JERSILD'S CLASSIFICATION

	Order of expression 1st	2nd	3rd	4th	5th	6th	Total	
I. *Specific material objects and possessions*								
1 toys	8						8	
2. clothes, jewelry	10	4					14	
3. food	4						4	
4 vehicles	4	1	1				6	
5 pets	6						6	
6 farms	2		2				4	
Total	34	5	3					42
II. *Money*								
7. money	7	5		1		1	14	
8 wealth	4	27	1				32	
Total	11	32	1	1		1		46
III *Good living quarters*								
9. tidy house, etc.	6	3	2				11	11
IV *Activities, sports, diversions*								
10 reading	4						4	
11 sports	17	3	1		1		22	
12 movies	2						2	
13 vacation	0						0	
14. travel	19	2					21	
15 occasions	4						4	
16 parties	0						0	
17 tasks and undertakings	0						0	
Total	46	5	1		1			53
V. *Opportunities and accomplishments*								
18. specific education	0						0	
19. music	0						0	
20 personal accomplishments	10						10	
21 promotion in school	0						0	
Total	10							10
VI *Be independent*								
22. vocation	25		1				26	
23. be big	1						1	
Total	26		1					27
VII *Be bright*								
24 be bright	0		1				1	1

TABLE 1 (*continued*)

			Order of expression							
			1st	2nd	3rd	4th	5th	6th	Total	
VIII		*Moral self-improvement*								
	25	moral improvement	1						1	1
IX		*Improved personal appearance*								
	26	nice face	1						1	1
X.		*Prestige and adventure*								
	27	personal prestige	16		1		1		18	
	28	adventure	1	2					3	
		Total	17	2	1		1			21
XI	29	*Supernatural power*	0						0	
XII	30	*Have baby*	2	2					4	4
XIII		*Marriage*								
	31	get married	11	3	2	1			17	
	32	love and be loved	1						1	
		Total	12	3	2	1				18
XIV	33	*Parents never die*	0						0	
XV		*Companionship*								
	34	companionship	0						0	
	35	friends	0						0	
XVI		*Relief from irritations*								
	36.	duties	0						0	
	37	physical pain	0						0	
	38.	imaginary conditions	0						0	
XVII		*Specific benefits for parents and relatives*								
	39.	benefits	0						0	
	40	releases	0						0	
XVIII		*General inclusive benefits for self*								
	41	general benefits	0						0	
	42	health, happiness	41	8		1			50	
		Total	41	8		1				50
		Grand total	207	60	12	3	2	1		285

itself counted as a wish for marriage, under No 31 *When you grow up*, or the like, was not counted as a wish at all

Table 1 is of interest for only two or three points The most conspicuous one aside from the large proportion of first and single

wishes already mentioned, is in connection with wishes for *wealth*, Category 8. There were 27 second, compared with four first wishes for wealth. This seems to have been due not so much to relative values clear in the minds of the children as to the simple matter of convention. Social convention says, "May you be healthy and wealthy." The children followed this convention freely and made the double wish about 27 times. Thus the category *wealth* shows

TABLE 2

Comparison of the Wishes of Students, 11-12- and 5-6-Year-Old Children, and the Birthday Wishes of Grade One Pupils*

			Children		Birthday wishes	
		Students	11-12	5-6	All wishes	First wishes
	Number of wishes	387	100	100	285	207
	Classifications					
VI	Vocation	17.2	6	0	9.5	12.6
II	Money	14.8	6	5	16.8	5.3
IV	Activities, sports, diversions	11.2	8	6	18.6	22.2
XVIII	General inclusive benefits for self	10.9	6	3	17.5	19.8
XIII	To be married, have a lover	8.9	2	1	6.3	5.8
XXI	General benefits for others, philanthropies, etc	8.1	13	5	0	0
V	Opportunities and accomplishments	5.2	7	4	3.5	4.8
XV	Companionship, etc.	4.7	4	1	0	0
XX	General benefits for relatives	4.7	8	0	0	0
VII	Be bright, smart	2.9	1	0	0.4	0
XII	Have baby, sibling	2.3	4	6	1.4	1.0
VIII	Moral self-improvement	1.8	0	0	0.4	0.5
III.	Good living quarters	1.8	5	1	3.9	2.9
I	Specific material objects and possessions	1.6	14	55	14.0	16.4
X	Personal prestige, adventure	1.6	0	1	7.4	8.2
XVII	Specific benefits for parents and relatives	.8	7	3	0	0
XIV	Parents never die	.3	7	1	0	0
XIX	General immunities for self	.3	0	0	0	0
IX	Improved personal appearance	0.0	0	0	0.4	0.5
XI	Supernatural power	0.0	0	4	0	0
XVI	Relief from irritations, etc	0.0	1	2	0	0
	No responses, or unintelligible	0.0	1	2	0	0
	Totals	99.1	100	100	100.1	100.0

*The percentages shown for student and children groups were computed on slightly different bases. For the adults the three wishes given by each student were totaled and that used as the base to get the percentages. For the children the first wish only of each child was used.

27 second wishes, while the wishes for health in the double statement were all counted as first wishes

In all other cases, except two, the number of second wishes in any category was fewer, and usually many fewer, than that of first wishes. The two exceptions were Nos 28 and 30, for each of which three and four wishes only were made altogether, two of each being the second wishes The relatively small number of other than first wishes made is probably a matter characteristic of young children's minds In fact, for these children the *healthy and wealthy* wish was probably more like a single wish than two distinct ones

In Table 2 a comparison is made with the wishes of the students and other children groups, in terms of the percentages, showing both the total 285 and the 207 first birthday wishes The arrangement of the categories is in order of the size of the percentages for the students

From this table it may be seen that no birthday wishes were made for several objects for which the other groups expressed interest. The chief of these categories, according to the other groups were XXI, *general benefits for others, philanthropies, etc*; XV, *companionship*, XX, *general benefits for relatives*, XVII, *specific benefits for parents and relatives*, XIV, *that parents never die.* These omissions from the birthday wishes seem clear enough on the grounds that the social culture in which children in our country grow up makes birthdays occasions on which interests are centered on the celebrant: *he* receives good wishes, gifts, and marked attention It is conceivable, of course, that such occasions might be times when one would think first of kin, friends, and the needs of the world Indeed, friends of the writer made a great boyhood impression upon him by observing a birthday on their return from South America by having the celebrant bear gifts to friends and relatives, as was the custom of an Indian tribe encountered on their trip But the children of this birthday study have been good learners of the ideals and customs of their own land!

In several classifications the birthday wishes show considerably higher percentages than those of the children in the other groups and in some cases greater than those of the students. These were for

VI, vocations—the first wishes only, came nearer to the percentage for students than to that for the 11-12-year-old children	12 6% (207) 17 2% students 6 % 11-12-year-old 0 % 5- 6-year-old

XVIII, general benefits for self—greater than both children's and students' groups	19.8% (207)
	17.5% (285)
	10.9% students
	6 % 11-12-year-old
	3 % 5- 6-year-old
IV, activities and diversions—greater than both children's and students' groups	22.2% (207)
	18.6% (285)
	11.2% students
	8 % 11-12-year-old
	6 % 5- 6-year-old
XIII, marriage—nearer to the students' than to the children's groups	5.8% (207)
	6.3% (285)
	8.9% students
	2 % 11-12-year-old
	1 % 5- 6-year-old
X, prestige—greater than both childrens and students' groups	8.2% (207)
	7.4% (285)
	1.6% students
	0 % 11-12-year-old
	1 % 5- 6-year-old

In addition to those categories for which there were no birthday wishes, mentioned above, the birthday percentages in the following categories were lower than those of the other children's groups

XII, have baby or sibling—	1.0% (207)
	1.4% (285)
	4 % 11-12-year-old
	6 % 5- 6-year-old
I, specific material objects and possessions—lower than the 5-6-year-old children, about the same as the 1-12-year-olds	16.4% (207)
	14.0% (285)
	14 % 11-12-year-old
	55 % 5- 6-year-old

Two explanations for these differences may be made besides the point given above that the setting of the wishes had some effect upon their formulation. One of them is that the mental maturity of the children was much above average. This is indicated by an average *IQ* of 132 by the Stanford Revision of the Binet-Simon Intelligence Test. It is also evidenced by the phrasing of the wishes. Many of the sentences were compound or complex, and were free from childish errors, while a few had mature elaborations, for example, *"I hope you will be a famous piano player like Handel."* This relatively advanced maturity would probably tend to produce ideas and interests more like older children and adults than like average 5-6-year-old children.

The second explanation is that the unusually favorable home background of these children was an important factor. Their socio-economic and cultural status was probably much more like that of the college students—the parents of most of the group were

college graduates—than like that of average children. The potency of the cultural background in which experience lies has been revealed in nearly all studies of wishes where that factor has been distinguished. A striking example is a study by Merescalchi (2).

> Studies were made of the wishes of 500 children in three Italian communities—Baricella, Castelmaggiore, and Bologna—at intervals of 35 years. The problem of what they would do if they were rich was put to them, without any explanation or suggestion by their teachers and they wrote down their answers. The girls, especially in the earlier period, evidenced more socialized desires than the boys. The wishes varied according to localities, but some things were common to all. Baricella was a poor, backward, unhealthful agricultural region in 1896. Practically all the girls stated that they would give money to the poor, and especially food, clothing, and wood. Only 75 per cent of the boys thought of giving to the poor, and then poor soldiers loomed large in their minds. In Castelmaggiore, inhabited mainly by fairly prosperous working men, there was less thought of giving to the poor and of enjoying good food and clothes and more desire for horses and carriages, trips and good houses, even palaces. In Bologna this trend was even more exaggerated, although some spoke of founding institutions for poor children, the aged, and the disabled. At the later period, Baricella had become a prosperous agricultural region and wishes had changed from food and charity to much the same desires as those of the children of Castelmaggiore and Bologna. The dominant wishes now are for automobiles, airplanes, radios, travel, palaces, and residence in cities (for the country children), and by the seaside (for city children). Frequently the parents and brothers and sisters are mentioned in wishes, and often some mention is made of a special need of some member of the family.

C. The Wishes in Chronological Order

Table 3 presents the wishes in chronological order. The names of the birthday children, the dates, and the names and wishes of each child making a wish statement are shown. The classificatory numbers for the categories to which the wishes were assigned are also given. The first set of wishes, those for October 24, is brief, due to the fact that the observer failed to record but the three statements shown, although other wishes were made. Other sets of

TABLE 3

The Wishes in Chronological Order

October 24—to John D.		
Richard K	I hope he will be a strong, healthy boy	42
Ruth	I hope he will go to Central Park.	11
Robert	I hope he will be a strong athlete	20
November 4—To Robert		
Joan	I hope you get a new watch	2
George B..	I hope you get an electric train	1
Richard K	I hope when you grow up you will be rich	8
Gaylord	I hope you will be a wealthy, healthy, and wise man when you grow up	8, 42, 24
Joan S	I hope he will be healthy and strong	42
Ruth J	I hope you will have lots of books when you grow up	10
Bill:	I hope you will get a new Ford car when you grow up.	4
November 15—To George B and Nancy M		
Bertram	I hope he will have lots of money to buy things and be strong and healthy.	7, 42
Tommy.	For both of them I hope they both go up to Saranac	14
Robert	I hope George gets an electric engine	1
Ruth J	I hope both of them will go to the show when they grow up	12
John D.	I hope they will be a healthy, wealthy lady and man when they grow up	42, 8
Peggy Mary	I hope they will be strong and healthy	42
Joan H	I hope they both grow up strong, too.	42
John D:	I hope George gets a sail boat	1
Bobbie:	I hope they ride in an airplane some day	11
November 20—To Ruth J.		
George B.	I hope you get a steam engine	1
Richard K.	I hope Ruth will marry a strong and wealthy man	31, 8
Randall	I wish she gets a nice doll house	1
Beth	I hope she goes on a train and sleeps overnight	14
Jean.	I hope she gets a nice golden ring	2
Portia.	I hope she will be a healthy, wealthy woman when she grows up	42, 8
George W..	I hope she gets a lot of books	10
Robert	I wish she would have a trip to Fire Island	14
Joan S	I wish she will be a healthy, strong lady.	42
Gaylord	I hope she will be healthy and earn a lot of money when she grows up	42, 7
Virginia	I hope she gets a doll.	1
Nancy M.	I hope she gets some doll furniture for the doll house	1
Robert	I hope Ruth is an artist	22
December 9—To Jane		
Gaylord	I wish you to grow up and be a healthy, strong lady and earn lots of money.	42, 7
Richard K..	Healthy, wealthy, strong and rich	42, 8
Joan S	I hope she is healthy, too	42

TABLE 3 (*continued*)

Bill	I hope she has a good house 9
Portia	I hope she earns lots of money 7
George B	I hope she has a good furnace with lots of heat 9
David	I hope she has lots of food 3
Bertram	I hope she sees new things 14
Ruth K	I hope you go to the show when you grow up 12
Bill	I hope she marries a wealthy, strong man 8, 31
Bobbie	I hope she gets a ride in an airplane 11
George W.	I hope she is able to swim 20
Richard K	I hope she goes in a seaplane, not in an airplane, because it is too dangerous 11
John D	I hope she gets a car when she grows up 4
December 17—To Joan	
David	I hope you have lots of money 7
Jean	I hope you have a nice golden watch 2
Robert	I hope she always has good eyesight 42
George B	I hope she has a nice house 9
Richard K.	Joan, I hope you will marry a nice man, and rich, too 31, 8
George W	I hope you will be able to swim 20
Portia	I hope she has lots of money and be very wealthy 7, 8
Joan S	I hope she grows up to be a healthy, strong woman, 42
Tommy	I hope you have happy times 42
Nancy L	I hope you will be a wealthy, healthy, strong woman 42, 8
Gaylord	I hope you will have a good car and live in peace 4, 42
George B	I hope you will have a Merry Christmas 15
Robert	I hope you will have a place where it is quiet 42
Jane	I hope you will have a nice Christmas tree 1
Richard C	I hope you will have a very tidy house 9
Bill	I wish you will go on a nice boat trip 11
Ruth K	I hope you will get to see a farm 14
Duane	I hope she is a healthy, wealthy lady 42, 8
Richard K	Joan, I hope you can live as long as you can help live 42
John D	I hope you are a healthy, wealthy woman 42, 8
Robert	I hope you get a pony 5
January 13—To George W	
Ruth J	I hope you get lots of books to read 10
Richard K	I hope when you grow up, when you marry your wife, you will have a nice tidy house 31, 9
Jane	I hope you will earn lots of money 7
Joan H	I hope he will be a healthy wealthy man 42, 8
Joan S	A healthy man 42
Bobbie	I hope you marry a good wife 31
David	I hope you are an aviator 22
John G	I hope you are a radio announcer 22
Duane	I hope you're a cowboy and sell lots of cattle 22, 7
Gaylord	I hope you have lots of money, a healthy man, and take a ride in an airplane 7, 42, 11
Bill	I hope you marry a healthy, strong girl 31
Ruth K	I hope you get to go horseback riding 11
Nancy M	I hope you have a happy birthday 15

TABLE 3 (*continued*)

Bertram.	I hope you are the king of America so he can earn lots of money 27, 7
Jean	I hope you get a golden watch. 2
Robert·	I hope he gets a trip to Fire Island 14
Duane·	I hope he is a healthy, wealthy cowboy. 42, 8, 22
John D	I hope he will be a fireman 22
Ruth K.	I hope when you grow up, I hope you are a good man and earn lots of money. 25, 7
George B.	I hope he has a nice farm 6
January 22—To Tommy	
Gaylord	I wish you have a very happy birthday 15
John D ·	I hope you will be a healthy, wealthy man when you grow up 42, 8
Ruth K.	I hope he gets to go horseback riding 11
Bertram:	I hope you will get a silver watch and a silver brush when you grow up. 2, 2
Jean	I hope you will get some baby ducks for Easter 5
Joan S	I hope you have a nice pony—a golden pony 5
Ruth J	I hope you will be an engineer when you grow up 22
Duane.	I hope you will be a healthy, wealthy man. 42, 8
Robert:	I hope some day you will go to Fire Island 14
Gaylord·	I wish you could see a lighthouse 14
Joan H.	I hope when you grow up you will be healthy and wealthy, and have a tidy house, a nice wife, and be President of the United States 42, 8, 9, 31, 27
David	I hope you will go to Sky Top 14
George W:	I hope he goes on top of the Empire State Building 11
Joan S ·	I hope you will have a white pony 5
Randall:	I hope you have a ride in an airplane 11
David	I hope you marry a nice woman 31
Virginia·	I hope you get a car when you grow up 4
Portia·	I hope you get a golden watch 2
Bobbie.	I hope you will be well enough to go out in the snow and play 42, 11
January 28—To Richard K	
Joan H	I hope you have a gold watch. 2
Robert	I hope you go to Fire Island 14
John D	I hope he goes on top of the Empire State Building and does everything in the world 11, 28
Bill:	I hope you will be a healthy, wealthy, well, and strong man 42, 8
Gaylord:	I hope you have a golden watch, a golden tooth brush, and an automobile 2, 2, 4
John G·	I hope you're a radio announcer 22
Jean	I hope at Easter you will have baby ducks 5
Duane·	I hope you will get to go horseback riding 11
George B:	I hope you have a farm in the country. 6
Ruth J..	I hope you are an architect 22
Duane	I hope you're President of the United States 27
Bobbie.	I hope you get a new sweater 2

TABLE 3 (*continued*)

Robert.	I hope you will be an acrobat 22
John G	I hope you are a healthy, wealthy man 42, 8
John D	I hope he gets a nice house and a nice woman 9, 31
Bertram	I hope you are the President of the United States 27
Duane	I hope you are an engineer 22
David	I hope you are an aviator 22
February 5—To John G	
Gaylord	I hope you will be a big, healthy, wealthy, and happy boy, go on a ferry, and earn lots of money 23, 42, 8, 42, 11, 7
John D.	I hope you will be a healthy, wealthy man. 42, 8
Bobbie	I hope you will be a healthy, wealthy man 42, 8
Randall	I hope you will be a healthy, wealthy man with lots of money 42, 8, 7
Bill	I hope you will be a healthy, wealthy man and earn lots of money 42, 8, 7
David	I hope you are a game hunter 22
Nancy L	I hope you will be a healthy, wealthy, strong man 42, 8
Joan H	I hope you will be a healthy, wealthy man when you grow up and be President of the United States 42, 8, 27
Richard K	I hope you are happy when you grow up and go on a boat ride to Africa 42, 14
Ruth J	I hope you're an airplane pilot when you grow up 22
George W	I hope you learn how to swim well and also go on a boat ride to Africa. 20, 14
Robert	I hope you have a trip to Fire Island 14
Ruth K	I hope he has lots of books and will be happy 10, 42
Patricia	I hope you are a healthy, wealthy man 42, 8
Virginia	I hope you're the King when you grow up 27
Gaylord'	John, I hope you go for a ride to Africa and see all the animals there 14
Joan H.	I hope you go in a boat to Africa 14
Robert	I hope you will be an acrobat 22
Duane.	I hope you are an aviator 22
David	I hope you will go to England 14
Duane	I hope you will be President of the United States 27
Robert	I hope you will be a boat driver 22
Richard K..	I hope you grow up and like your wife very much 32
John D	I hope you will have children, a nice wife, and a tidy house 30, 31, 9
Gaylord'	John, I hope when you grow up you will be Popeye, the Sailor Man 27
February 18—To Jean	
Ruth J	I hope you go to Fire Island (She says it is Robert's wish; he is absent) 14
Richard	I hope you are very famous when you grow up 27
John G.	I hope you are a piano player 22
Nancy L.	I hope you learn how to swim very well and have a boat ride 11
John D	I hope you make a big, tall building (draw plans) 22

TABLE 3 (*continued*)

Bill	I hope when you grow up you will be a teacher in Horace Mann School 22
Patricia	I hope when you grow up you will be a healthy, wealthy girl 42, 8
Joan H	I hope you will be a famous piano player like Handel. 27
Michael	I hope when you grow up you will be very pretty. 26
Ruth J	I hope you will be a famous actress 27
Joan S	I hope you will have lots of oranges and apples 3
George B	I hope you go to Lake Placid 14
David	Jean, I hope you will be a famous artist 27
Richard K	Wherever you go and whatever you do, I hope you will be famous and when you marry I hope you will have a nice, tidy house 27, 31, 9
David	Jean, I hope when you grow up your husband will be a farmer 31
John G.	I hope when you grow up your husband will be an actor 31
Bill	I hope when you grow up you will have a nice house in the country 9
Joan H	I hope you will go to Africa. 14
Michael	Jean, I hope when you grow up you will have nice manners at the table when you eat 20
March 7—To Bertram	
Robert	I hope you will be an acrobat 22
Ruth J	I hope you're an engineer when you grow up. 22
Duane	I hope you are President of the United States 27
Nancy L	I hope you learn how to swim very well and you have a boat ride 20, 11
Gaylord	I hope you go to the Empire State Building and get a golden watch 11, 2
Joan H	I hope when you grow up you will be very famous and get a golden watch 27, 2
Virginia	I hope you have a nice wife and have a baby when you grow up 31, 30
Patricia	I hope you are a healthy, wealthy man when you grow up 42, 8
Ruth J	I hope when you grow up, or right now, you can go up to the Empire State and have a record made of yourself 11, 28
Bill	Bertram, I hope when you grow up you will be a wealthy, healthy man and earn lots of money 8, 42, 7
Gaylord	I hope you earn lots of money, have a tidy house, a nice wife, and go in an airplane and have a baby. 7, 9, 31, 11, 30
Duane	I hope you are an aviator when you grow up 22
Joan H.	I hope you get lots of bananas, apples, and oranges. 3
Robert	I hope you go to Fire Island 14
Michael	I hope when you grow up you won't eat much candy so your teeth don't get spoiled 42
March 13—To Nancy L	
Robert	I hope you have many happy birthdays 15

TABLE 3 (*continued*)

Bill	Nancy, I hope you learn how to make nice pictures 20
John G.	I hope, Nancy, you're a famous piano player 27
Joan H	I hope you learn to swim very well and get a boat 20, 4
Patricia.	I hope you are a healthy, wealthy woman 42, 8
Ruth J.	Nancy, I hope when you grow up you will be a very famous actress, go on every stage in New York City 27
Joan S	I hope you get pink ribbons for your hair 2
Gaylord	Nancy L, I hope when you're grown up you're a famous actress and go in the museum 27
Virginia	I hope you get a baby when you grow up 30
Michael	I hope when you grow up you can paint pictures, the *Queen Mary* and the *Normandie* 22
Ruth K.	I hope when you grow up you will be a healthy, wealthy lady 42, 8
John D.	I hope when you grow up you will go on an airplane ride 11
Duane	I hope you are a rider 22
David	I hope your husband will be a farmer 31
Robert	I hope you're able to dive out of a canoe where it is deep water 20
Virginia	I hope you get a ride in an airplane 11
Jean	I hope you get chicks for Easter. 5
John D	I hope she goes out in a great big boat ride and the motor gives out 28
John G.	I hope when you grow up you will be a movie actor 22
Ruth J	I hope when you grow up or right now you will have a ride on a horse or a pony 11
Duane	I hope you will go to Fire Island 11
Joan H	I hope when you grow up or now you get lots of oranges and apples 3

wishes than those on the chart were probably made but not recorded because the observer was absent from the room at the time of the birthday celebrations Unfortunately, also, no record was made later than March 13th, and the first birthday party of the year was not recorded

It would have been interesting to compare the wishes made at the very beginning of the year with those made the very last of the year. A comparison of the two November sets with the two for March may be made, however The number of statements made in March was greater than in November, although the number of pupils in school was practically the same Twenty-two were made in November; 38 in March The number of wishes showed a still greater difference 26 were made in November, 52 in March The sentences used in March tended to be longer than those of November

Table 4 compares the November wishes with the March ones according to the categories of the classificatory analysis. In March

TABLE 4

Comparison of November and March Wishes by Sub- and Main Categories

	Sub-categories	Nov.	March	Main categories	Nov.	March
1.	toys	6				
2	clothes, jewelry	1	3			
3.	food		2	I	7	7
4.	vehicles		1			
5	pets		1			
6.	farms					
7	money	2	2	II	5	6
8	wealth	3	4			
9	tidy house, etc		1	III	0	1
10	reading	1				
11	sports	1	7			
12.	movies	1		IV	6	10
13.	vacation					
14.	travel	3	2			
15.	occasions		1			
16	parties					
17	tasks, etc					
18.	specific education					
19	music					
20.	accomplishments		4	V	0	4
21.	promotion					
22	vocation	1	6	VI	1	6
23.	be big					
24	be bright					
25	moral improvement					
26.	nice face					
27.	prestige		5	X	0	7
28	adventure		2			
29	supernatural power					
30.	have baby		3	XII	0	3
31.	marriage		3	XIII	0	3
32.	be loved					
33.	parents never die					
34	companionship					
35.	friends					
36.	duties					
37	physical pain					
38.	imaginary conditions					
39.	benefits for relatives					
40	releases					
41	general benefits for self					
42.	health, happiness	7	5	XVIII	7	5
	Totals	26	52		26	52

the variety was greater, due in part, no doubt, to the greater number of wishes made, but probably also due in part to the wider interests

of more mature children. The March wishes also showed greater maturity as to objects wished for. For example, in March no children made wishes for toys, although six of the November wishes were of that nature Another indication of increasing maturity was in the wishes for vocational affairs In March, six such wishes were made, in November but one Four wishes in March were for personal accomplishments, there were none in November Seven March wishes were for prestige, there were none in November Three others in March were for babies and three for marriage compared with none such in November.

The greater maturity shown in the March wishes was probably due in considerable degree to the practice the children had had in making birthday wishes throughout the year Practice or learning, however, can rarely, if ever, be separated from maturity which is due to biological growth In fact, one of the principles of the

TABLE 5

Wishes of Each Child by Sex and Date

BOYS	
1—Gaylord	*14 statements* *33 wishes*
11/4 To Robert	I hope you will be a healthy, wealthy and wise man when you grow up 8, 42, 24
11/20 to Ruth J.	I hope she will be healthy and earn a lot of money when she grows up 42, 7
12/9 to Jane	I wish you to grow up and be a healthy, strong lady and earn lots of money. 42, 7
12/17 to Joan	I hope you will have a good car and live in peace. 4, 42
1/13 to George W	I hope you have lots of money, a healthy man, and take a ride in an airplane 7, 42, 11
1/22 to Tommy*	I wish you have a very happy birthday. 15
1/22 to Tommy	I wish you could see a lighthouse 14
1/28 to Richard K.	I hope you have a golden watch, a golden tooth brush and an automobile 2, 2, 4
2/5 to John G	I hope you will be a big, healthy, wealthy and happy boy, go on a ferry and earn lots of money. 23, 42, 8, 42, 11, 7
2/5 to John G*	John, I hope you go for a ride to Africa and see all the animals there 14
2/5 to John G*	John, when you grow up I hope you will be Popeye, the Sailor Man 27
3/3 to Bertram	I hope you go to the Empire State Building and get a golden watch 11, 2
3/3 to Bertram	I hope you earn lots of money, have a tidy house, a nice wife, and go in an airplane, and have a baby. 7, 9, 31, 11, 30
3/13 to Nancy L*	Nancy L, I hope when you're grown up you're a famous actress and go in the museum. 27

TABLE 5 (*continued*)

Summary

Distribution of wishes by category numbers

Category No.	F	Category No	F		
2	3i	23	1	Number of different categories	14
4	2	24	1	Percentage of immature wishes	9%
7	5m	27	2	Percentage of mature wishes	51%
8	2m	30	1	Number of 1-wish statements	5
9	1	31	1m	Number of 2-wish statements	4
11	4	42	7m	Number of 3-wish statements	3
14	2m	—	—	Number of 4-wish statements	0
15	1	14	33	Number of 5-wish statements	1
				Number of 6-wish statements	1

2—John D	*13 statements* *21 wishes*
11/15 To George B and Nancy M ·	I hope they will be a healthy, wealthy lady and man when they grow up 42, 8
11/15 to George B.	I hope George gets a sail boat 1
12/9 to Jane·	I hope she gets a car when she grows up. 4
12/17 to Joan	I hope you are a healthy, wealthy woman 42, 8
1/13 to George W.	I hope he will be a fireman 22
1/22 to Tommy	I hope you will be a healthy, wealthy man when you grow up 42, 8
1/28 to Richard K.	I hope he goes on top of the Empire State Building and does everything in the world 11, 28
1/28 to Richard K:	I hope he gets a nice house and a nice woman, 9, 31
2/5 to John G	I hope you will be a healthy, wealthy man 42, 8
2/5 to John G	I hope you will have children, a nice wife, and a tidy house 30, 31, 9
2/18 to Jean·	I hope you make a tall building. (Draw plans) 22
3/13 to Nancy L	I hope when you grow up you will go on an airplane ride 11
3/13 to Nancy L	I hope she goes out in a great big boat ride and the motor gives out 28

Summary

Distribution of wishes by category numbers

Category No.	F	Category No	F		
1	1i	22	2m	Number of different categories	10
4	1	28	2	Percentage of immature wishes	5%
8	4m	30	1	Percentage of mature wishes	55%
9	2	31	2m	Number of 1-wish statements	6
11	2	42	4m	Number of 2-wish statements	6
		—	—	Number of 3-wish statements	1
		10	21		

3-Duane	*13 statements* *18 wishes*
12/17 To Joan	I hope she is a healthy, wealthy lady 42, 8
1/13 to George W	I hope you're a cowboy and sell lots of cattle 22, 7
1/13 to George W	I hope he is a healthy, wealthy cowboy 42, 8, 22
1/22 to Tommy	I hope you will be a healthy wealthy man 42, 8

TABLE 5 (*continued*)

1/28 to Richard K	I hope you will get to go horseback riding	11
1/28 to Richard K	I hope you're President of the United States	27
1/28 to Richard K	I hope you are an engineer	22
2/5 to John G	I hope you are an aviator	22
2/5 to John G	I hope you will be President of the United States	27
3/3 to Bertram	I hope you are President of the United States	27
3/3 to Bertram	I hope you are an aviator when you grow up	22
3/13 to Nancy L	I hope you are a rider	22
3/13 to Nancy L	I hope you will go to Fire Island	14

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
7	1m	22	6m	Number of different categories	7
8	3m	27	3	Percentage of immature wishes	0%
11	1	42	3m	Percentage of mature wishes	78%
14	1	7	18	Number of 1-wish statements	9
				Number of 2-wish statements	3
				Number of 3-wish statements	1

4—Robert *18 statements* *18 wishes*

10/24 To John D	I hope he will be a strong athlete	20
11/15 to George B	I hope George gets an electric engine	1
11/20 to Ruth J	I wish she would have a trip to Fire Island	14
11/20 to Ruth J	I hope Ruth is an artist	22
12/17 to Joan	I hope she always has good eyesight	42
12/17 to Joan	I hope you will have a place where it is quiet	42
12/17 to Joan	I hope you get a pony	5
1/13 to George W	I hope he gets a trip to Fire Island	14
1/22 to Tommy	I hope some day you will go to Fire Island	14
1/28 to Richard K	I hope you will go to Fire Island	14
1/28 to Richard K	I hope you will be an acrobat	22
2/5 to John G	I hope you have a trip to Fire Island	14
2/5 to John G	I hope you are an aviator	22
2/5 to John G	I hope you will be a boat driver	22
3/3 to Bertram	I hope you will be an acrobat	22
3/3 to Bertram	I hope you go to Fire Island	14
3/13 to Nancy L	I hope you have many happy birthdays	15
3/13 to Nancy L	I hope you're able to dive out of a canoe where it is deep water	20

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
1	1i	20	2	Number of different categories	7
5	1i	22	5m	Percentage of immature wishes	11%
14	6m	42	2m	Percentage of mature wishes	72%
15	1	—	—	Number of 1-wish statements	18
		7	18		

TABLE 5 (*continued*)

5—Richard K.	*11 statements*	*18 wishes*
10/24 To John D.	I hope he will be a strong, healthy boy 42	
11/4 to Robert:	I hope when you grow up you will be rich. 8	
11/20 to Ruth J:	I hope Ruth will marry a strong and wealthy man 31, 8	
12/9 to Jane.	Healthy, wealthy, strong and rich 42, 8	
12/9 to Jane	I hope she goes in a seaplane, not in an airplane, because it is too dangerous. 11	
12/17 to Joan	Joan, I hope you will marry a nice man and rich, too 31, 8	
12/17 to Joan.	Joan, I hope you can live as long as you can help live 42	
1/13 to George K	I hope when you grow up, when you marry your wife you will have a nice tidy house 31, 9	
2/5 to John G.	I hope you are happy when you grow up and go on a boat ride to Africa 42, 14	
2/5 to John G	John, I hope you grow up and like your wife very much 32	
2/18 to Jean	Wherever you go and whatever you do, I hope you will be famous, and when you marry I hope you will have a nice tidy house 27, 31, 9	

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
8	4m	27	1	Number of different categories	8
9	2	31	4m	Percentage of immature wishes	0%
11	1	32	1	Percentage of mature wishes	72%
14	1m	42	4m	Number of 1-wish statements	5
		—	—	Number of 2-wish statements	5
		8	18	Number of 3-wish statements	1

6—Bill	*11 statements*	*17 wishes*
11/4 To Robert	I hope you will get a new Ford car when you grow up 4	
12/9 to Jane	I hope she has a good house 9	
12/9 to Jane	I hope she marries a wealthy, strong man 8, 31	
12/17 to Joan	I wish you will go on a nice boat trip 11	
1/13 to George W..	I hope you marry a healthy, strong girl 31	
1/28 to Richard K.	I hope you will be a healthy, wealthy, well and strong man 42, 8	
2/5 to John G	I hope you will be a healthy, wealthy man and earn lots of money 42, 8, 7	
2/18 to Jean	I hope when you grow up you will be a teacher in Horace Mann School 22	
2/18 to Jean	I hope when you grow up you will have a nice house in the country. 9	
3/3 to Bertram	Bertram, I hope when you grow up you will be a wealthy, healthy man and earn lots of money. 8, 42, 7	

TABLE 5 (*continued*)

3/13 to Nancy	Nancy, I hope you learn how to make nice pictures 20

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
4	1	20	1	Number of different categories	9
7	2m	22	1m	Percentage of immature wishes	0%
8	4m	31	2m	Percentage of mature wishes	71%
9	2	42	3m	Number of 1-wish statements	7
		—	—	Number of 2-wish statements	2
11	1	9	17	Number of 3-wish statements	2

7—David	*11 statements* *11 wishes*
12/9 To Jane	I hope she has lots of food 3
12/17 to Joan	I hope you have lots of money 7
1/13 to George W	I hope you are an aviator 22
1/22 to Tommy	I hope you will go to Sky Top 14
1/22 to Tommy	I hope you marry a nice woman 31
1/28 to Richard K	I hope you are an aviator 22
2/5 to John G	I hope you will be a game hunter 22
2/5 to John G	I hope you will go to England 14
2/18 to Jean	Jean, I hope you will be a famous artist 27
2/18 to Jean	Jean, I hope when you grow up your husband will be a farmer 31
3/13 to Nancy L	I hope your husband will be a farmer 31

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
3	1i	27	1	Number of different categories	6
7	1m	31	3m	Percentage of immature wishes	9%
14	2m	—	—	Percentage of mature wishes	82%
22	3m	6	11	Number of 1-wish statements	11

8—John G	*7 statements* *8 wishes*
1/13 To George W	I hope you are a radio announcer 22
1/22 to Richard K	I hope you're a radio announcer 22
1/22 to Richard K	I hope you are a healthy, wealthy man 12, 8
2/18 to Jean	I hope you are a piano player 22
2/18 to Jean	I hope when you grow up your husband will be an actor 31
3/13 to Nancy L	I hope, Nancy, you're a famous piano player 22
3/13 to Nancy L	I hope when you grow up you will be a movie actor 22

Summary

Distribution of wishes by category numbers

Category No.	F	Category No	F		
8	1m			Number of different categories	4

TABLE 5 (*continued*)

22	5m	Percentage of immature wishes	0%
31	1m	Percentage of mature wishes	100%
42	1m	Number of 1-wish statements	6
—	—	Number of 2-wish statements	1
4	8		

9—George B — *8 statements* — *8 wishes*

11/4 To Robert	I hope you get an electric train 1
11/20 to Ruth J.	I hope you get a steam engine 1
12/9 to Jane	I hope she has a good furnace with lots of heat 9
12/17 to Joan	I hope she has a nice house 9
12/17 to Joan	I hope you will have a Merry Christmas 15
1/13 to George W.	I hope he has a nice farm 6
1/28 to Richard K	I hope you have a nice farm in the country 6
2/18 to Jean	I hope you go to Lake Placid 14

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
1	2i	14	1m	Number of different categories	5
6	2	15	1	Percentage of immature wishes	25%
		—	—	Percentage of mature wishes	13%
9	2	5	8	Number of 1-wish statements	8

10—Bertram — *5 statements* — *8 wishes*

11/15 To George B	I hope he will have lots of money to buy things and be strong and healthy 7, 42
12/9 to Jane.	I hope she sees new things 14
1/13 to George W	I hope you are the King of America so he can earn lots of money 27, 7
1/22 to Tommy	I hope you will get a silver watch and a silver brush when you grow up 2, 2
1/28 to George K.	I hope you are President of the United States 27

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
2	2i	27	2	Number of different categories	5
7	2m	42	1m	Percentage of immature wishes	25%
		—	—	Percentage of mature wishes	50%
14	1m	5	8	Number of 1-wish statements	2
				Number of 2-wish statements	3

11—George W — *5 statements* — *6 wishes*

11/20 To Ruth J.	I hope she gets a lot of books 10
12/9 to Jane.	I hope she is able to swim 20
12/17 to Joan	I hope you will be able to swim. 20
1/22 to Tommy	I hope he goes on top of the Empire State Building 11
2/5 to John G	I hope you learn how to swim well and also go on a boat ride to Africa 20, 14

TABLE 5 (*continued*)

Summary

Distribution of wishes by category numbers

Category No	F	Category No.	F
10	1		
11	1		
14	1m		
20	3		
—	—		
4	6		

Number of different categories	4
Percentage of immature wishes	0%
Percentage of mature wishes	17%
Number of 1-wish statements	1
Number of 2-wish statements	1

12—Randall	*3 statements*	*5 wishes*
11/20 To Ruth J.	I wish she gets a nice doll house 1	
1/22 to Tommy	I hope you have a ride in an airplane 11	
2/5 to John G	I hope you will be a healthy, wealthy man with lots of money 12, 8, 7	

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
1	1i	11	1
7	1m	42	1m
		—	—
8	1m	5	5

Number of different categories	5
Percentage of immature wishes	20%
Percentage of mature wishes	60%
Number of 1-wish statements	2
Number of 3-wish statements	1

13—Michael	*4 statements*	*4 wishes*
2/18 to Jean	I hope when you grow up you will be very pretty 26	
2/18 to Jean	Jean, I hope when you grow up you will have nice manners at the table when you eat 20	
3/3 to Bertram	I hope when you grow up you won't eat much candy, so your teeth don't get spoiled 42	
3/13 to Nancy L	I hope when you grow up you can paint pictures, the *Queen Mary* and the *Normandie* 22	

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
20	1		
22	1m		
26	1		
42	1m		
—	—		
4	4		

Number of different categories	4
Percentage of immature wishes	0%
Percentage of mature wishes	50%
Number of 1-wish statements	4

14—Richard C.	*2 statements*	*2 wishes*
12/17 To Joan	I hope you will have a very tidy house 9	
2/18 to Jean	I hope you are very famous when you grow up 27	

TABLE 5 (*continued*)

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
9	1			Number of different categories	2
27	1			Percentage of immature wishes	0%
—	—			Percentage of mature wishes	0%
2	2			Number of 1-wish statements	2

15—Tommy *2 statements* *2 wishes*

11/15 To George B. and Nancy M.	For both of them I hope they go to Saranac 14
12/17 to Joan	I hope you have happy times. 42

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
14	1m			Number of different categories	2
42	1m			Percentage of immature wishes	0%
—	—			Percentage of mature wishes	100%
2	2			Number of 1-wish statements	2

GIRLS

1—Joan H *13 statements* *22 wishes*

11/4 To Robert	I hope you get a new watch 2
11/15 to George B and Nancy M	I hope they will both grow up strong, too 42
1/13 to George W	I hope he will be a healthy, wealthy man 42, 8
1/22 to Tommy.	I hope when you grow up you will be healthy and wealthy and have a tidy house, a nice wife, and be President of the United States 42, 8, 9, 31, 27
1/28 to Richard K	I hope you will have a gold watch 2
2/5 to John G.	I hope you will be a healthy, wealthy man when you grow up, and be President of the United States 42, 8, 27
2/5 to John G	I hope you go in a boat to Africa 14
2/18 to Jean.	I hope you will be a famous piano player like Handel. 27
2/18 to Jean	I hope you will go to Africa 14
3/3 to Bertram	I hope when you grow up you will be very famous and get a golden watch 27, 2
3/3 to Bertram	I hope you get lots of bananas, apples and oranges 3
3/13 to Nancy L.	I hope you learn to swim very well and get a boat. 20, 4
3/13 to Nancy L.	I hope when you grow up or now you get lots of oranges and apples 3

TABLE 5 (*continued*)

Summary

Distribution of wishes by category numbers

Category No.	F	Category No.	F		
2	3i	20	1	Number of different categories	10
3	2i	27	4	Percentage of immature wishes	23%
4	1	31	1m	Percentage of mature wishes	46%
8	3m	42	1m	Number of 1-wish statements	8
9	1	—	—	Number of 2-wish statements	3
14	2m	10	22	Number of 3-wish statements	1
				Number of 5-wish statements	1

2—Ruth J	*12 statements* *13 wishes*
11/4 To Robert	I hope you will have lots of books when you grow up 10
11/15 to George B. and Nancy M	I hope both of them will go to the show when they grow up 12
1/13 to George W	I hope you get lots of books to read 10
1/22 to Tommy	I hope you will be an engineer when you grow up 22
1/28 to Richard K.	I hope you're an architect 22
2/5 to John G	I hope you're an airplane pilot when you grow up 22
2/18 to Jean	I hope you go to Fire Island (She says that is Robert's wish, he is absent) 14
2/18 to Jean	I hope you will be a famous actress. 27
3/3 to Bertram	I hope you're an engineer when you grow up 22
3/3 to Bertram	I hope when you grow up or right now, you can go to the Empire State and have a record made of yourself 11, 28
3/13 to Nancy L	Nancy, I hope when you grow up you will be a very famous actress, go on every stage in New York City. 27
3/13 to Nancy L	I hope when you grow up or right now you will have a ride on a horse or pony 11

Summary

Distribution of wishes by category numbers

Category No.	F	Category No.	F		
10	2	22	4m	Number of different categories	7
11	2	27	2	Percentage of immature wishes	0%
12	1	28	1	Percentage of mature wishes	17%
		—	—	Number of 1-wish statements	11
14	1m	7	13	Number of 2-wish statements	1

3—Ruth K	*7 statements* *10 wishes*
12/9 To Jane	I hope you go to the show when you grow up 12
12/17 to Joan	I hope you will get to see a farm 14
1/13 to George W.	I hope you will get to go horseback riding 11
1/13 to George W	I hope when you grow up I hope you are a good man and earn lots of money 25, 7

TABLE 5 (*continued*)

1/22 to Tommy	I hope he gets to go horseback riding 11
2/5 to John G.	I hope he has lots of books and will be happy 10, 42
3/13 to Nancy L	I hope when you grow up you will be a healthy, wealthy lady 42, 8

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
7	1m	12	1
8	1m	14	1m
10	1	25	1
11	2	42	2m
		—	—
		8	10

Number of different categories	8
Percentage of immature wishes	0%
Percentage of mature wishes	50%
Number of 1-wish statements	4
Number of 2-wish statements	3

4—Nancy	*6 statements* *10 wishes*
11/20 To Ruth J :	I hope she gets some doll furniture for the doll house 1
12/17 to Joan	I hope you will be a healthy, wealthy, strong woman 42, 8
1/13 to George W	I hope you will have a happy birthday 15
2/5 to John G	I hope you will be a healthy, wealthy, strong man 42, 8
2/18 to Jean	I hope you learn how to swim very well and have a boat ride 20, 11
3/3 to Bertram	I hope you learn how to swim very well and have a boat ride 20, 11

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
1	1i	20	2
8	2m	42	2m
11	2	—	—
15	1m	6	10

Number of different categories	6
Percentage of immature wishes	10%
Percentage of mature wishes	50%
Number of 1-wish statements	2
Number of 2-wish statements	4

5—Joan S	*9 statements* *9 wishes*
11/4 To Robert	I hope he will be healthy and strong 42
11/20 to Ruth J ·	I hope she will be a healthy, strong lady 42
12/9 to Jane	I hope she is healthy, too 42
12/17 to Joan	I hope she grows up to be a healthy, strong women. 42
1/22 to Tommy.	I hope you will have a nice pony, a golden pony 5
1/22 to Tommy	I hope you will have a white pony 5
1/13 to George W	A healthy man 42
2/18 to Jean	I hope you will have lots of oranges and apples 3
3/13 to Nancy L	I hope you get pink ribbons in your hair 2

TABLE 5 (*continued*)

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
2	1i		
3	1i		
5	2		
42	5m		
—	—		
4	9		

Number of different categories	4
Percentage of immature wishes	22%
Percentage of mature wishes	55%
Number of 1-wish statements	9
Number of 2-wish statements	0

6—Bobbie *6 statements* *8 wishes*

11/15 To George B and Nancy	I hope they ride in an airplane some day 11
12/9 to Jane	I hope she gets a ride in an airplane 11
1/13 to George W	I hope you marry a good wife 31
1/22 to Tommy	I hope you will be well enough to go out in the snow and play 42, 11
1/28 to Richard K	I hope you get a new sweater 2
2/5 to John G	I hope you will be a healthy, wealthy man 42, 8

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
2	1	31	1m
8	1m	42	2m
11	3	5	8

Number of different categories	5
Percentage of immature wishes	13%
Percentage of mature wishes	50%
Number of 1-wish statements	4
Number of 2-wish statements	2

7—Patricia *4 statements* *8 wishes*

2/5 To John G	I hope you are a healthy, wealthy man 42, 8
2/18 to Jean	I hope when you grow up you will be a healthy, wealthy girl 42, 8
3/3 to Bertram	I hope you are a healthy, wealthy man when you grow up 42, 8
3/13 to Nancy	I hope you are a healthy, wealthy woman 42, 8

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F
8	4m		
42	4m		
—	—		
2	8		

Number of different categories	2
Percentage of immature wishes	0%
Percentage of mature wishes	100%
Number of 1-wish statements	0
Number of 2-wish statements	4

TABLE 5 (*continued*)

8—Virginia	*6 statements*	*7 wishes*
11/20 To Ruth J	I hope she gets a doll	1
1/22 to Tommy	I hope you get a car when you grow up	4
2/5 to John G	I hope you're the King when you grow up	27
3/3 to Bertram	I hope you have a nice wife and have a baby when you grow up	31, 30
3/13 to Nancy·	I hope you get a baby when you grow up	30
3/13 to Nancy.	I hope you get a ride in an airplane	11

Summary

Distribution of wishes by category numbers

Category No	F	Category No.	F		
1	1i	27	1	Number of different categories	6
4	1	30	2	Percentage of immature wishes	14%
11	1	31	1m	Percentage of mature wishes	14%
		—	—	Number of 1-wish statements	5
		6	7	Number of 2-wish statements	1

9—Portia	*4 statements*	*6 wishes*
11/20 To Ruth J	I hope she will be a healthy, wealthy woman when she grows up	42, 8
12/9 to Jane	I hope she earns lots of money	7
12/17 to Joan	I hope she has lots of money and be very healthy.	7, 8
1/22 to Tommy	I hope you get a golden watch	2

Summary

Distribution of wishes by category numbers

Category No	F	Category No.	F		
2	1			Number of different categories	4
7	2m			Percentage of immature wishes	17%
8	2m			Percentage of mature wishes	82%
42	1m			Number of 1-wish statements	2
—	—			Number of 2-wish statements	2
4	6				

10—Jean	*6 statements*	*6 wishes*
11/20 To Ruth J.:	I hope she gets a nice golden ring	2
12/17 to Joan	I hope you have a nice golden watch	2
1/13 to George W	I hope you get a golden watch	2
1/22 to Tommy	I hope you will get some baby ducks for Easter	5
1/28 to Richard K.·	I hope at Easter you will have baby ducks	5
3/13 to Nancy·	I hope you get chicks for Easter	5

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
2	3			Number of different categories	2
5	3			Percentage of immature wishes	100%
—	—			Percentage of mature wishes	0%
2	6			Number of 1-wish statements	6

TABLE 5 (*continued*)

11—Jane 2 *statements* 2 *wishes*

12/17 To Joan.	I hope you will have a nice Christmas tree	1
1/13 to George W	I hope you will earn lots of money.	7

Summary

Distribution of wishes by category numbers

Category No	F	Category No	F		
1	1i			Number of different categories	2
7	1m			Percentage of immature wishes	50%
				Percentage of mature wishes	50%
2	2			Number of 1-wish statements	2

Wishers Unknown 2 *statements* 3 *wishes*

Peggy Mary (the doll for whom the house was built)

11/5 To George B and Nancy	I hope they will be strong and healthy	42, 8

Beth (not identified by that name)

11/20 To Ruth J	I hope she goes on a train and sleeps overnight.	14

Summary

Number of 1-wish statements	1
Number of 2-wish statements	1

educative process is that practice or training should accompany biological growth, guiding it toward desired development

D. The Wishes Arranged by Pupils Making Them

Table 5 gives all the wishes of each child arranged successively in chronological order The number of wish statements and the total number of wishes are given beside each pupil's name. At the left of each wish statement are given the date and the name of the receiver of the wish, and at the right of each the category numbers under which each wish of the statements was classified. Below the last statement of each child is a tabulation of his or her wishes according to the category numbers. The number of *immature* and *mature* wishes is indicated in this tabulation by the letters *i* and *m*, and the percentages of each are shown. Lastly the numbers of single, two, three, five, or six wish statements are given. The arrangement on the chart is by sex, and within each sex set, in the order of the total number of wishes made by each boy or girl.

There were 15 boys and 11 girls for whom wishes were recorded The numbers are hardly sufficient to warrant extended analysis, either as a total group or by sex, but because of interesting points

TABLE 6
NUMBER OF CHILDREN MAKING GIVEN NUMBERS OF STATEMENTS AND WISHES

	Statements frequency	Wishes frequency
33-34		1
31-32		0
29-30		0
27-28		0
25-26		0
23-24		0
21-22		2
19-20		0
17-18	1	4
15-16	0	0
13-14	3	1
11-12	4	1
9-10	2	3
7- 8	3	6
5- 6	6	4
3- 4	4	1
1- 2	3	3
Total	26	26

found a few tables are presented Table 6 shows the distributions of the numbers of wish statements and of separate wishes made by the group as a whole The distributions show considerable ranges for each grouping Three pupils, for example, made only one or two wishes that were recorded during the whole year, while one gave 18 statements and another made 33 different wishes. The frequencies hardly approach a normal distribution, but they indicate that children vary greatly in their expressiveness of birthday wishes for one another.

Table 7 shows the distributions of pupils according to the plurality of wishes in their statements Every pupil made at least one statement containing a single wish The number of these simply expressed wishes per pupil ranged from one made by one pupil to 18 made by another child There were 15 pupils who made double wishes, and these 15 ranged from one per pupil to six made by one child. Seven pupils made three wish statements, one giving as many as three. No statements contained four wishes only, but two pupils each made one of five wishes and one made a statement containing six wishes

Just what the significance of these differences may be is perhaps a matter of opinion From the side of sentence structure simple,

TABLE 7

DISTRIBUTIONS ACCORDING TO NUMBER OF WISHES PER WISH STATEMENT

	Number of wishes in statements					
	1	2	3	4	5	6
18	1					
11	2					
10	0					
9	2					
8	2					
7	1					
6	3	1				
5	3	1				
4	4	3				
3	0	3	1	0		
2	7	2	1	0		
1	1	5	5	0	2	1
0	0	11	19	26	24	25
Total	26	26	26	26	26	26

short, and clear sentences are usually considered preferable to long involved ones In child development, however, length of sentence has been found to be quite closely related to maturity in language use Probably this is true for the birthday wishes of these children Another suggestion is that longer statements may be associated with love of verbosity, ego-regard, or the like

The analyses of wishes below each child's set makes possible a superficial comparison of the interests of the children The number of categories covered by the 26 pupils varied from one to 14. Some children repeated wishes again and again, others made many different wishes For example, Robert specialized on *Fire Island*, Jean made two wishes for a golden watch, one for a golden ring, and three for baby ducks or chicks On the other hand John D scattered 21 wishes over 10 different categories

The studies of wishes of students and other children groups have indicated that wishes for *7, money, 8, wealth, 14, travel, 22, Vocation, 31, marriage, and 42, health* and *happiness,* tend to be more mature wishes, and those for *1, toys, 2, clothes, etc., 3, food,* and *5, pets,* immature wishes Table 8 gives a distribution of the percentages of these two groups of wishes by sexes. The number of cases is small, but the differences are quite marked, both between individuals and between sexes The boys seem to have shown marked

TABLE 8

Distributions of the Percentages of Immature and Mature Wishes by Sexes

%	Girls Immature	Girls Mature	Boys Immature	Boys Mature	Total Immature	Total Mature
100	1	1		2	1	3
90						
80		1		1		2
70				4		4
60				1		1
50	1	5		3	1	8
40		1				1
30						
20	2		3		5	
10	4	2	1	3	5	5
0	3	1	11	1	14	2
Total	11	11	15	15	26	26
Median	18	53	7	65	9	56

maturity over the girls in their wishes. A similar tendency was found in a comparison of college men and women (4), the former seeming to show more mature wishes.

Table 9 gives the comparison of the boys and girls according to the percentages of wishes by the sub-categories. It appears from this table that the following differences obtained for these children.

(a) The girls were more interested in
- Jewelry — 9% girls 2 8% boys
- Pets — 5% girls 0 6% boys

(b) The boys were more interested in
- Vocations — 12 9% boys 4% girls
- Travel and diversions — 8 9% boys 3% girls
- Tidy house — 5 6% boys 1% girls
- Marriage — 7.2% boys 3% girls

The comparison of college men and women referred to above showed a similar greater interest by men in vocations and marriage The same data, however, showed that more college women than men were interested in travel and diversions.

E Summary and Conclusions

Analyses of 285 birthday wishes made to one another by 26 Grade I children are presented The following findings and tentative conclusions are offered.

1. Most of the wishes were single statements, excepting a number

TABLE 9

COMPARISON OF WISHES OF BOYS AND GIRLS ACCORDING TO CATEGORIES AND IN PERCENTAGES

Categories		Percentages Boys	Girls
1	toys	2 8	3
2	clothes, jewelry	2 8	9
3	food	6	3
4	vehicles	2 2	2
5	pets	6	5
6	farms	1 1	0
7	money	6 7	4
8	wealth	10 6	13
9	tidy house, etc	5 6	1
10	reading	6	3
11.	sports	6 2	9
12	movies	0 0	2
13	vacation		
14	travel	8 9	3
15	occasions	1 7	1
16	parties		
17	tasks, etc		
18	specific education		
19.	music		
20	accomplishments	3 9	3
21	promotion		
22.	vocation	12 9	4
23	be big	6	0
24	be bright	6	0
25.	moral improvement	0 0	1
26.	nice face	6	0
27	prestige	5 6	7
28.	adventure	1 1	1
29	supernatural power		
30	have baby	1 1	2
31	marriage	7 2	3
32	be loved	6	0
33	parents never die		
34	companionship		
35	friends		
36.	duties		
37.	physical pain		
38.	imaginary conditions		
39	benefits for relatives		
40.	releases		
41	general benefits for self		
42.	health, happiness	15 6	20
	Total	100 2	99

of conventional wishes that the recipient "be healthy and wealthy"

2. *Compared with personal wishes reported in other studies,*

these birthday wishes omitted nearly all "altruistic" wishes, and showed considerably greater proportions of wishes for vocational career, activities and diversions, marriage, and prestige than other groups of children, and less interest in specific material possessions, and having a baby or sibling.

3. Important factors entering into these differences may be greater mental maturity and more favorable home background of these Grade I children than of the other groups.

4. Wishes made in March were more numerous and complex than wishes made in November, due in part, probably, to practice and maturation as well as to other factors.

5. Great individual differences were found in the number, objectives, maturity and immaturity of the wishes of these children.

6. Boys' wishes tended to be quite markedly more mature and numerous than the girls', especially as to vocations, travel, living quarters, and marriage

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INTERCORRELATIONS AMONG LEARNING ABILITIES I

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A. PROBLEMS

Generality versus specificity is one of the most important problems in psychology at the present time. We ask whether intellectual ability is general or unique to the particular task being attempted, whether a personality trait is general or applies to each situation separately, whether an emotion is general or specific, and whether abilities are general or specific. Possibly more experimental work has been done in the field of intelligence than in the other problems.

In this study we are interested in the relationships among learning abilities. The writer desired to treat learning scores in a way similar to the treatment of totals on sub-tests on intelligence examinations. In intelligence we have three theories: That intelligence is a general function, that abilities run in groups, and that one's abilities are highly specific. Present opinions seems to be between the general and group factor theories.

Now, is learning ability as general as intellectual ability seems to be? Educational psychologists seem to assume that it is. They speak of fast learners and slow learners, without the qualification of mentioning what is learned rapidly or slowly.

B. PREVIOUS STUDIES

The specific problem of intercorrelation among learning abilities has been attacked by several investigators, chiefly (in chronological order) by Pyle, Garrett, Anastasi, and Hall. In addition a determined reader could uncover hundreds of correlations between two or three tests reported as incidental to their main problems by researchers in all fields of learning.

Hall has given the best summary and critical discussion of this whole problem. He presents a list of thirteen "irrelevant factors

*Received in the Editorial Office on September 30, 1938.

which may raise or lower intercorrelations between learning tasks," which he feels account in part for the consistently low coefficients found by all those who have worked on this problem. Readers interested in this discussion are advised to read Hall's original article, as we can mention here only one or two of the leading factors One of the most important is that in these investigations a narrow range of talent has been tested. The *IQ* range of college students is largely confined within a 20-point limit, which means statistically that slight differences in special abilities and other incidental factors, and minor discrepancies within the experimental situation, will materially lower correlations In many studies, also, due to practical limitations of running each subject through a number of tests, researchers have tended to use too few subjects and to shorten the tests to such an extent that they have lost both reliability and validity.

Studies by Garrett and Anastasi employed chiefly very short pencil and paper tests done in group situations Their median intercorrelations were around +.20 The present writer felt at the outset that these techniques, which are fairly typical of work in this field, might be responsible for the virtual lack of agreement among learning skills So it was decided to use longer tests, to test subjects individually, and to use more apparatus tests and fewer pencil and paper tests

C. Tests and Techniques

1. *Tests*

The tests which we finally decided to use are listed in Table 1 The tests themselves were chosen from a vast number of possible measures of learning Those requiring complicated apparatus were somewhat limited to the resources of our own laboratory

The final list of tests was drawn up with several criteria in mind: They should cover several different fields of learning—motor, rote memory, ideational learning; there should not be too many of largely similar character, and similar functions should be tested in different ways, as by auditory and visual presentation

Even after the tests had been selected, the order in which they should be given was a problem of great importance. The following points were among the major considerations.[1]

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[1]The writer wishes to acknowledge many suggestions, verbal and by letter, on the part of Dr John A McGeoch Also the members of the

TABLE 1
ORDER OF TESTS USED

	First day	Class of test	Approximate time
1	Study faces	II*	4
2	Spool packing	I	7
3	Memory for faces	II	5
4	Rational learning	III	15
5	Mirror drawing	I	13 44 min
	Second day		
6.	Prose, auditory	III*	8
7	Cancellation	I	13
8	Maze learning	II	18
9	Persian-English, visual	II	10
10.	Test memory for prose	III	6 55 min
	Third day		
11	Prose, visual	III*	8
12	Code transliteration	II	10
13	Pursuit rotor	I	5
14	Incidental memory for code	II	3
15	Card sorting	I	8
16	Hindu-English, auditory	II	10
17	Test memory for prose	III	6 50 min

*These tests were not measures in themselves, but memory was tested in a subsequent test.
I, motor tests· II, rote learning tests, III, ideational tests

1. We rotated among the various classes of tests.

2. We attempted to eliminate or minimize positive and negative transfer.

3. Retroactive inhibition on the memory tests was avoided by interpolating materials of very different natures, such as spool packing between learning faces and testing for memory of faces

4 We separated those tests which required the maximum amounts of concentration, both within a session and into different days

5. We used motor tests as partial rests from the more strenuous intellectual activities

6 The first day's testing was made not too difficult, as all our subjects were naive and we attempted to avoid possible discouragement

department seminar at the University of Wisconsin, directed by Professor V A C Henmon, and attended by all staff members and graduate students, gave me many suggestions in regard to tests and procedures

7 A regular order of testing was maintained The tests might have been mixed up, or rotated This might have reduced certain systematic trends, such as fatigue or practice effects But the ordering and timing of tests was so difficult that administrative difficulties would have arisen with any other than a standard order. Finally, it seemed to the writer that a constant order would be best, as all subjects would be treated alike and the same forces should theoretically have worked with all learners

I shall not attempt to justify the classification of our tests into motor, rote, and intellectual Such division merely represents the best compromise we could effect to satisfy the various criteria listed above, especially that of varying the nature of successive tests, both within a day's session and between one week and the next.

2 *Techniques*

Several different advanced students acted as experimenters, so carefully standardized procedures were prepared and typewritten The director of the project personally instructed the experimenters, demonstrated the techniques on them and on several trial subjects, and occasionally checked to ensure identical treatment of all subjects Techniques were relatively simple, any way.

We shall now briefly describe the various tests

(1). *Learning names and faces* This was the first sub-test from Moss's test of social intelligence Subjects were given four minutes to associate a dozen names and faces.

(2) *Spool packing* This a part of R. H Seashore's motor skills unit. The subject picks up one spool with each hand, places them in a tray A dozen spools fill one tray, filling five trays constitutes one trial Five trials were done

(3). *Memory for names and faces* Twenty-five faces, including the original 12, are presented the subject, along with the 12 original names. He is to pair the proper names and faces

(4). *Rational learning* This is a mental maze test, in which the subject is read three digits, one of which represents the correct choice He is told only "right" or "wrong," no second guess being given if he selects one of the wrong alternatives. He continues until he has learned the correct digit in all eight sets of three digits.

(5) *Mirror drawing* Five trials in this familiar star tracing test.

(6). *Auditory prose* The subject was read a thousand word passage, adapted from the chapter on Australia from Van Loon's Geography. He was told that at the end of the hour he would be given a brief examination on the material.

(7) *Cancellation* Five trials, cancelling all the *R*'s in paragraphs of pied capital letters.

(8). *Maze learning.* A 10-turn, multiple-*T*, raised wire pathway finger maze The subject continued until he satisfied the criterion of three successive errorless trials

(9). *Persian-English, visual* Eleven pairs of words were chosen for having four letters in both Persian and English (the Persian being turned into the standard Roman alphabet), and were presented at two-second intervals on an electrically driven rotating drum After the third trial the English equivalents were covered, and the subject was prompted after a second and a half, if necessary Trials continued until three were achieved without any prompting

(10) *Memory for prose passage* A five-minute test, largely objective, tested the memory of the subject for the material which had been read to him at the beginning of the hour in Test 6

(11) *Visual prose* A passage, similar in nature to that used in Test 6, this one on India, was read by the subject himself

(12). *Code substitution* Two-digit numbers, in random arrangement, were to be substituted for capital letters. Forty substitutions constituted one trial, five trials were done.

(13). *Pursuit rotor.* This test also came from Seashore's motor skills unit The subject followed with a loosely hinged pointer a target about the size of a five-cent piece placed near the edge of a phonograph turntable. Contacts were automatically recorded by an electric counter The subject did five trials of twenty revolutions each

(14) *Incidental memory for code.* The subjects had done Test 12 without any suspicion of being asked for memory, now they were given a blank alphabet and asked to fill in as many of the number equivalents as possible.

(15) *Card sorting* A deck of 40 cards, a standard deck minus the face cards, was to be sorted in the "one behind" method (see 5) Five trials were administered.

(16). *Hindu-English, auditory* This test was paired with Test 9, being auditory instead of visual. Eleven words were chosen for

being of four letters both in Hindu and English They were read aloud to the subject, at the rate of about one pair every two seconds, the same time which was allowed by the visual exposure apparatus. After three trials the Hindu word only was pronounced, and if the subject did not give the English equivalent within a second and a half, he was prompted. Three perfect trials were accepted as evidence of learning

(17). *Visual prose memory.* The examination on the prose read by the subject himself was now given, the procedure being the same as for the parallel Test 10

3 *Subjects*

We used 100 subjects, taken during three different semesters from the writer's lecture course in beginning psychology[2] The usual homogeneities and heterogeneities of any college population were present. No subject was taken from an advanced course, and no subject was used who had by any chance ever been subjected to any of these tests.

Each subject was individually tested for a total of three hours, each hour period separated from the other by a week's lapse of time. This fitted in excellently with college schedules Subjects seemed well motivated and interested in the test battery This is mentioned here because in Part III to be reported subsequently, where we used longer tests, boredom and loss of interest became a factor. In this first experiment, tests were short, of no great difficulty, and with rather quick shift from one type of activity to another At worst, subjects were motivated to finish and leave as soon as possible

D. Results

The major results are contained in the table of intercorrelations presented herewith One may refer back to Table 1 for the names of the tests which space permits mention only by number in Table 2. Tests 1, 6, and 11 are necessarily omitted from Table 2 since they did not have measures of their own, but had subsequent memory tests. The final row of correlations is between the learning or memory score and intelligence.

One is immediately impressed by the fact that these correlations are in the main exceedingly low. Taking the usual criterion of demanding that a coefficient, to be significant, should be at least

[2]The following advanced students ran many of the subjects through these tests Natalie Weisberg, Robert Campbell, Edward Straty, Leo Herman

TABLE 2
INTERCORRELATIONS AMONG THE LEARNING TESTS

	Test number (see Table 1)													
	2	3	4	5	7	8	9	10	12	13	14	15	16	17
3	.18													
4	16	04												
5	04	11	01											
7	09	04	10	38										
8	06	00	38	.25	—11									
9	17	26	23	13	—05	32								
10	—06	27	27	—04	—06	08	22							
12	32	05	21	—13	07	—05	33	09						
13	16	03	03	.27	12	21	—06	10	—06					
14	03	23	05	05	06	20	16	09	04	22				
15	26	25	23	.24	—04	—04	28	29	45	22	14			
16	06	25	25	.00	—04	22	53	05	17	19	20	18		
17	04	16	24	23	—03	22	20	25	11	04	18	31	27	
Int	10	—01	02	22	—13	10	—10	—05	19	05	—15	—06	—16	29

Probable errors are in the neighborhood of 10 $N = 100$
No intercorrelations as reported for Tests 1, 6, 11, since these are learning tests whose measures were obtained from Tests 3, 10, and 17, respectively

three times its probable error, we see that even with our good sized group of one hundred subjects there are only eight figures which attain the desired magnitude. The first conclusion, then, would be that various learning tests involve different abilities, and that inter relationships with each other and with general intelligence are virtually non-existent We give in Table 3 a distribution of the coeffi-

TABLE 3
DISTRIBUTION OF COEFFICIENTS OF CORRELATION

Correlation range	Number of r's
50 to 59	1
.40 to 49	1
30 to 39	6
20 to 29	26
.10 to 19	19
00 to 09	23
—10 to —01	14
—20 to —11	1

cients of correlation among the various measures of learning, omitting those with intelligence

This distribution coincides almost exactly with that quoted by Hall in summarizing the coefficients obtained by a number of investigators using a variety of tests and measures The present writer might admit that at the outset he felt that learning abilities must truly be much more highly intercorrelated than the coefficients obtained by Garrett and Anastasi, in particular, suggested This was the reason we went to considerable trouble to use largely instrumental tests, and to run 100 subjects individually through three hours of testing apiece It was our opinion that such procedure might result in higher correlations

But the fact that the various techniques and various tests used by the present and previous investigators produce results so largely in agreement suggests that these trends must be valid Then, as a general recommendation, we would suggest that one should speak of learning abilities (in the plural), not of a learning ability as if it were a general factor or a general ability equally applicable to every learning task.

Is there any consistency about the appearance of high and low correlations? Let us observe first that the few slightly negative correlations can be considered inconclusive, just as can those which

are slightly positive. Those which fall within the range of —.10 to +.10, and even up to +.20 are so near their *PE*'s that the trends prove little. This wider range covers nearly two-thirds of our coefficients.

We have sub-divided the intercorrelations into three groups, composed of tests of somewhat similar demands. These are given in Tables 4, 5, and 6. We find a slight trend as one might expect: the

TABLE 4

INTERCORRELATIONS AMONG MOTOR TESTS

	2	5	7	13
5	04			
7	09	38		
13	16	27	12	
15	26	21	—04	22

TABLE 5

INTERCORRELATIONS AMONG ROTE LEARNING TESTS

	3	8	9	12	14
8	04				
9	26	32			
12	05	—05	33		
14	23	20	16	04	
16	25	22	53	17	20

TABLE 6

INTERCORRELATIONS AMONG IDEATIONAL TESTS

	4	10
10	27	
17	24	25

median among the motor tests is +.19, among rote learning tests it is +.20, and it rises to +.25 with the three intercorrelations among ideational tests. Since the figures shown in Tables 4 and 5 vary from slight negative to moderately high positives, there does not appear to be any group factor in evidence.

Looking for the moment at some of the highest single coefficients, we see that they occur when rather similar functions are being tested. The highest of any of the 91 correlations was that between learning Persian-English associates visually and learning Hindu-

English associates in an auditory manner Certainly these demand very similar abilities The next highest correlation is between code substitution and card sorting, although these were arbitrarily listed as involving different functions, they both involve a serial eye-hand coordination. Yet, this rule does not always hold, nor does the generally assumed one that correlations between complex functions are higher than between simple tests, as the coefficient of agreement between auditory and visual memory is only + 25 Theoretically, this should have been the highest on the list

E. Discussion

While in a scientific investigation one should preserve a rigid impartiality and accept his findings as facts, at least under the conditions observed, at the same time one cannot help being surprised at the low range of correlations among our various tests We realize that there is no special reason for assuming that there should be a general learning ability, beyond its commonly being mentioned tacitly as if it were such. We also tend to assume that because learning is a fairly complex function it must be fairly well correlated with general intelligence, which again would suggest that it is a fairly unitary ability. We notice from the last row of correlations in Table 2 that learning scores and intelligence are virtually unrelated

We mentioned earlier in the paper that Hall had suggested 13 factors which influence the magnitude of intercorrelations among learning abilities. Most of these serve to lower these coefficients Let us re-examine Hall's list in terms of the present investigation (*a*) Certainly range of talent applies here. We used college students, hence nearly the same in age, of no wide variation in intelligence, with practically the same educational background, all in their first course in psychology, and finally we might suggest that their aims and outlooks on life are rather similar (*b*) Similarity in age and culture possibly serve to raise a correlation. (*c*) Another attenuating factor which we are forced to admit is a slight unreliability of measurement Even with subjects doing three hours of work, to manage 17 tests demanded shortening of many to possibly an undesirable degree. (*d*) The measure of learning we used was perforce the total scores of the subjects in all trials, more or less on the assumption that all started with about an equal

skill, and the faster learners had better scores as time went on, hence their totals should have been lower in time or greater in quantity than for those who did not improve so much This reasoning is more theoretical than practical however Actually, some subjects caught on to the nature of the test earlier than others, and some were aided by more rapid eye or hand coordination, which permitted better scores due to native or previously acquired skill, and not necessarily through learning The writer might append here that the score to use in such an investigation as this is very difficult to decide Relative gain sounds logical, but it is not applicable in some tests, such as the maze Also such a figure favors the person with a poor initial score, as the person whose first trial happens to be good is nearer to his ultimate limit and later increments are achieved only with extreme difficulty

*Some of these potential shortcomings are being studied in investi*gations, which will be reported shortly

F. SUMMARY

1. One hundred college students were measured on 17 different tests of learning and memory, in three sessions of an hour apiece, one week apart The tests were of motor, rote, and ideational character.

2. Our purpose was to see if there is any general learning ability, or possibly groups of abilities, or whether we should properly speak of learning abilities as indicating that each person brings a different amount of learning ability to bear on each different type of task

3 The intercorrelations were very low, only 8 of the 91 being +.30 or greater They were mostly positive, however, the few negative ones were in the close neighborhood of zero.

4. There is some evidence that the correlations are somewhat higher between abilities of the same general character, and especially when the functions are not only in the same group, say motor, but when they involve largely similar tasks, such as serial reaction

5 Coefficients are only very slightly higher among the more complex functions than among simple motor or rote learning tasks

6 Correlations with intelligence are so weak as to be practically negligible.

7. The whole trend of evidence is such as to suggest very strongly that we must speak of learning abilities (plural) and not of learning ability (singular) as if it were a general ability Unless

there is a great deal of overlapping in the nature of the tasks, interrelationships are very low

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The Journal of Genetic Psychology, 1939, 55, 365-379

A STUDY OF THE BEHAVIOR RECORDS OF ADULTS WHO, WHEN THEY WERE IN SCHOOL, WERE JUDGED TO BE DULL IN MENTAL ABILITY[1]

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A. INTRODUCTION

The results of a previously conducted investigation into the post-school careers of a group of mentally deficient individuals (2) provided, in turn, the motive for the study herein to be reported.

The earlier investigation dealt primarily with the record of social and economic adjustment of 200 mentally deficient subjects in comparison with a like number of persons of average intelligence. The study indicated, among other things, that a rather sizeable percentage of such high-grade morons can be wholly self-supporting (27 per cent) and law-abiding (68 per cent of those who, at the time of the investigation were not in institutions for the feeble-minded, qualified under this latter criterion of adjustment). Adding the fact that approximately 57 per cent of the subnormals were partially self-supporting, in addition to the 27 per cent who were wholly self-supporting, and observing that fully half of those who had records of law violation were not repeaters in crime (having avoided further trouble with the law after a parole by the juvenile court, for instance), suggested the possible advisability of conducting a follow-up investigation of the post-school careers of a group of individuals whose level of mental ability would be located between that of the subnormals of the earlier study and the level called "average" or "normal" intelligence. These are the individuals generally referred to as "dull" in mental ability.

The present report deals with but one aspect of the careers of the persons who were made the subjects of this study, namely, the incidence of delinquency and crime found in their life histories. In its entirety the investigation is intended to furnish a detailed record of the social and economic adaptation of this "dull" population, a

[1]Received in the Editorial Office on October 7, 1938.

record which may be compared, point for point, with the results of the earlier study of markedly deficient[1] and of normal subjects

From an examination of the literature dealing with the relationship of intelligence, or deficiency of intelligence, and delinquency, it is evident that relatively few studies have been directed specifically to the adjustment of the dull subject. Much has been written about the feebleminded, and under very general references to the "mentally deficient" one is guided to inferences concerning those persons who are neither feebleminded nor of average intelligence Another predominant characteristic of the literature (important from the standpoint of the present study) is that, with very few exceptions, the reports have dealt with institutional populations. This is especially true of the few investigations that have centered attention upon the dull and the borderline classifications That a large part of the literature has overemphasized the rôle of feeblemindedness in delinquency has been the contention of a number of writers on the problems of juvenile and adult offenders. The present viewpoint owes much to the studies of Murchison (11), Burt (3), and Healy and Bronner (8).

Representative of statements made regarding the presence of the below-normal subject in institutional populations is the following comment by Shakow and Millard who reported a study of 150 white male adult delinquents examined at the Worcester County (Massachusetts) Jail by members of the psychological staff of the Worcester State Hospital They write

> Although the group does not differ significantly from an Army group given the Stanford-Binet in mean mental age, it has a greater incidence of subjects at the dull intellectual levels The incidence of feeblemindedness by the criterion of an *IQ* of 70 is not different (15, p 454)

Their summary of the percentages representing the various intellectual levels shows a predominance of the borderline type. Others

[1]The terms "markedly deficient" and "definitely deficient" are used throughout this discussion to refer to those persons whose mental development is so retarded as not to reach above a mental age of ten or eleven years on a fifteen-year basis For the purposes of this study 70 *IQ* is arbitrarily taken as the upper limit of the range occupied by this group On the same basis (as will be further explained in another section) the "dull" subjects referred to in the present investigation rated intelligence quotients from 75 to 85

who have shown a proportionately heavy representation of the group below normal and above feebleminded are Lane and Witty (10) whose tabulations of the numbers of cases falling within several mental ability categories shows 45.7 per cent between *IQ* 70 and *IQ* 89 as against 10 per cent below 70 *IQ* and 40 3 per cent from 90 to 110 *IQ* These findings were reported for 700 delinquents *in the St Charles (Illinois) School for Boys* A brief report by Rogers and Austin (14) for 3,584 cases appearing before the Toronto Juvenile Court indicates the same general conclusion They add this final remark, "The peak [of the curve of distribution of *IQ*'s] coming at this level of ability may imply a failure for this type (dull normal) of child to adjust satisfactorily to our public school system." Frank (6) in an investigation of mental level as a factor in the criminal tendencies of 401 individuals admitted to the New Jersey Reformatory at Rahway, found the "borderline" cases to constitute 10 1 per cent of the population and the "inferior" group 38 9 per cent as compared with 37 7 per cent for the "average" mental abilities Steinbach (16, p 696), in a study of juvenile delinquents seen at the Norfolk (Virginia) Juvenile Court found evidence that, "there are in the group as many normally intelligent as there are feeble-minded delinquents," and "a larger number of offenders is found in the borderline group than is found in any other group." Further evidence of the predominance of the dull individual in delinquent populations is supplied in a recent study reported by Jameson (9) the investigation having to do with psychological factors related to the delinquency of girls in state institutions.

That the just-below-normal level of intelligence makes more than its proportionate contribution to reformatory and penal institution populations, when compared with the much larger "normal" section of the curve of distribution is apparently the judgment of the majority of writers. It is not so evident, however, that the dull group predominates over the definitely deficient (the so-called "feebleminded") in terms of relative representation of the respective "sections" of the curve of distribution of intelligence As is clearly brought out in several reviews of the literature the earlier studies seemed to support the conclusion that feeblemindedness, per se, played a major part in delinquency, and that the feebleminded made, by all odds, the largest contribution to the records of delinquency and criminality It is unnecessary here to reappraise the

earlier literature, for adequate discussions are to be found in several good reports, among the best being Zeleny (18), Sutherland (17, pp. 357-375), Reckless and Smith (13, pp 81-116) and Lane and Witty (10).

There are studies of relatively recent date which, like the earlier literature, claim a proportionately greater representation of the feebleminded among penal and correctional institution groups This seems to be the conclusion of Erickson (5), who took the material for his study from the case history files of the psychiatric Field Service of the Wisconsin Board of Control; records of 1,690 cases of adult, white criminals He found that the relationship between deficiency of intelligence and criminality became more marked as the distance down from normal intelligence became greater (5, p. 621). This view appears also to be held by Glueck and Glueck (7, p 101) in a comparison made between juvenile delinquents and Massachusetts school children, where 13 1 per cent of the juvenile delinquents fell below 70 *IQ* as compared with 1 5 per cent of the school children, 17 1 per cent of the delinquents and 5.5 per cent of school children were in the "borderline" zone, 28 2 per cent of delinquents and 14 per cent of school children were classified as dull, while 41 6 per cent of the delinquents and 79 per cent of the school children rated "normal" or above Doll's summary of studies made in New Jersey state correctional institutions (4) gives support to the argument that, at least among younger delinquents, the rates of feeblemindedness run quite out of proportion to the presence of feeble mindedness in the general population

Findings which indicate that in the records of delinquency, persons of definitely deficient intelligence represent their mental level in proportionately smaller numbers than will be found among the dull and the borderline groups are difficult to locate, and where definite statements are made they leave one with the feeling that in no other comparison are the hazards of ambiguous terms more pronounced (those who are "borderline" in one report are "feebleminded" in another) Perhaps the present study can throw some light upon the specific question here raised as to the possibility that the feebleminded may be less represented in certain forms of delinquency not only on a numerical basis but in terms of the proportions of such persons to be found in the general population

At this point the writer wishes to record his belief that the

question raised above regarding the behavior of the dull individual in comparison with persons of greater or lesser intelligence is not simply an academic question There are matters of some practical importance which relate to the truth about the adjustment of individuals whose mentality is on the just-below-normal level What if it is shown that a relatively poorer adjustment is made by such persons than by the individuals of average intelligence? And, what are we to say if it should be clear that the dull person does not make a better adjustment than those who are his mental inferiors, the so-called high-grade morons? There are writers who are not convinced that the evidence to be found in the literature points unequivocally to the fact of better adjustment by the dull person than by high grade morons. (The gradual shift of estimates of median intelligence for inmate populations from markedly low in the earlier literature, to just-below-normal, in much of the recent literature, would add to this impression)

If there is not clearly a better adjustment on the part of the dull group (as compared with the mentally deficient), does that indicate that we are failing in our programs of education to provide as carefully for their individual needs as for persons of average and for those of markedly deficient intelligence? In this connection a statement by Dr Harry J Baker, Director of the Psychological Clinic of the Detroit Schools is pertinent It touches not only upon the relation of the instructional program to the needs of the dull pupil, but also adds further testimony in support of the belief that behavior cases are recruited in relatively larger numbers from this particular mental level He says.

> Studies of the mental abilities of children with behavior problems show a very great preponderance of cases clustering around the lower 80's in intelligence quotients There is a small percentage of children definitely feebleminded at one extreme of this distribution and a suitable number of average and a few bright children classified as behavior problems This distribution is very similar to that obtained in other school systems such as Chicago in which the average intelligence quotient of children with behavior problems is also about 82 It is believed that these dull children are bright enough to show some initiative and to create certain disturbances in school and society but they are not sufficiently intelligent to forsee the results and consequences of their anti-

> social actions From the standpoint of education it is very important that adjustments be made in the way of modified curricula and material suited to their needs, so that these children do not become dissatisfied or discouraged by their education (1, p 169).

Another statement with a similar point of view is made by Ploscowe when he remarks

> To some extent the fact that the dull-normal, backward children present more behavior problems is attributed to the fact that no special provision is made for them within the school system The failings of the clearly defective are recognized but the backward children are expected to meet the exigencies of a school system which is unsuited to them (12, p 47).

Through in-school training and post-school guidance, schools will, presumably, be in a position to make needed corrections as more facts are available concerning the later-life adjustments of persons who, in school, exhibited dull and borderline levels of ability To the not-very-large body of information dealing with such cases, the findings of the present study are added

B. The Plan and Procedure Employed in the Present Study

It is with respect to procedure that the study here presented differs most from others pertaining to the adjustment of persons of below-average intelligence As stated briefly in the foregoing discussion, the plan called for a follow-up of the careers of subjects who, when they were enrolled in the classes of the Lincoln, Nebraska, public schools, gave evidence of possessing less-than-average but not a feeble-minded grade of intelligence Only such persons were chosen as seemed reasonably certain of belonging in this category and only those persons who had, at the time the study was initiated, reached their twenty-first birthday

The difficulties involved in selecting subjects who could quite certainly qualify in such a classification were many. For one thing the results of group tests of mental ability had to be preferred over results from individual tests. Only a small percentage of the dull pupils of the schools had ever been examined with individual tests and in many such instances the references for individual examination followed from the fact of already established problem behavior.

Recognition of the unreliabilities of group test results led to adop-

tion of several precautions, among them being (*a*) the use of such names only as showed close agreement between the ratings on two or more group tests,[2] (*b*) the use of no name where ratings fell below an intelligence quotient of 75 or went above an intelligence quotient[3] of 85, (*c*) the elimination of all cases where there was any question that language handicaps influenced the test results and (*d*) the dropping of cases where birthdates were in question. The results of three group tests were accepted. The Terman *Group Test of Mental Ability, Forms A* and *B*, the Otis *Group Intelligence Tests, Form A*, and the *National Intelligence Tests*. Under the terms of this method of selection there were 307 individuals who qualified as belonging to the "dull" classification, 161 of these being males and 146 females.

In order to provide a basis of comparison upon which the behavior of the dull subjects might be evaluated, there was paired with each one a person of normal intelligence (*IQ* between 100 and 120)[4] whose nationality and sex were the same and whose chronological age did not differ more than 12 months from that of the dull subject. Table 1 presents a summary of the equivalence and the differences of these two groups.

TABLE 1

THE MEAN AGES AND INTELLIGENCE QUOTIENTS OF DULL AND CONTROL SUBJECTS*

Age and intelligence quotients	Dull subjects Male	Dull subjects Female	Control subjects Male	Control subjects Female
Mean age in months	317.64	318.64	319.56	318.44
SD's of the age in months	31.84	31.40	33.16	31.32
Mean intelligence quotients	79.54	80.82	107.84	105.92
SD's of intelligence quotients	3.04	2.84	4.92	4.82

*The ages of the subjects are here computed to May 1, 1938.

[2]Where results of several group tests were recorded there must have been no marked disagreement on the part of any one test—otherwise the case was omitted. Some cases were included with a record of but one test where other substantiating evidence was available.

[3]While the range from 75 to 85 *IQ* is quite arbitrary it does have the value of helping to eliminate cases which, due to the vagaries of testing programs, might more correctly have been classified in the so-called "normal" group, above 90 *IQ*, or, at the other extreme, in the definitely deficient category, below 70 *IQ*. The records of more than 20,000 former pupils of the Lincoln schools were examined among which were approximately 1,000 whose mental tests placed them in the range here indicated. Scarcely a third of these 1,000 names survived the further process of selection for the study.

[4]This particular range was chosen because it had been used in the earlier study (2) and employing it in this investigation insures a better comparison between the two studies.

When the names of the two lists of subjects were arranged as stated above, their records were cleared with the Lincoln Child Welfare Bureau and with the Social Service Exchange of the Lincoln Council of Social Agencies. With these preliminary steps taken, the cases were followed through the records of more than a dozen agencies and institutions in order to satisfy the question of the number of persons who had at some time been charged with delinquency. Subjects were either seen in person or interviews were arranged with close acquaintances or relatives by way of gaining clues to misconduct not recorded by courts and other agencies. (The interviewing of subjects constituted an important phase of the more extended study of which this is one part.) The following sections will present the results of the investigation thus conducted.

C. The Incidence of Delinquency and Criminality in the Records of Dull Individuals

By assuming that the conduct records of the group called "control subjects" represent the adjustment one might expect of persons of normal intelligence it is possible, through a process of comparison, to get some idea of the success or failure of the 307 dull subjects of this study. Furthermore, by comparing the records of the dull

TABLE 2
THE CONDUCT RECORDS OF MENTALLY DULL AND OF CONTROL SUBJECTS

	Dull subjects Male (161)		Dull subjects Female (146)		Dull subjects Both sexes (307)		Control subjects Male (161)		Control subjects Female (146)		Control subjects Both sexes (307)	
	N	%	N	%	N	%	N	%	N	%	N	%
Juvenile court	21	13.04	8	5.48	29	9.45	5	3.11	4	2.74	9	2.93
Police court	36	22.36	5	3.42	41	13.35	11	6.84	2	1.37	13	4.24
City and county jail	18	11.18	2	1.37	20	6.52	4	2.48			4	1.28
Industrial school Commitment	6	3.73	3	2.05	9	2.93	1	.62	1	.68	2	.64
Reformatory (medium security for adults) commitment	5	3.11	2	1.37	7	2.28	0		0		0	
Penitentiary commitment	1	.62	0		1	.32	0		0		0	

subjects with the results of the earlier study of individuals of markedly deficient intelligence (2) another method of evaluation can be applied. Table 2 furnishes some facts relative to the frequencies with which the dull subjects and the subjects of normal intelligence have contributed to delinquency. Table 3, reproduced from the

TABLE 3

THE CONDUCT RECORDS OF MENTALLY DEFICIENT AND CONTROL SUBJECTS 1935 STUDY*

	Subnormal subjects						Control subjects					
	Male (126)		Female (80)		Both sexes (216)		Male (126)		Female (80)		Both sexes (206)	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Juvenile court	32	26.02	17	23.28	49	25.00	6	4.84	2	2.56	8	3.96
Police court	31	25.21	4	5.48	25	17.86	12	9.67	1	1.23	13	6.43
City and county jail	17	13.82	1	1.37	18	9.18	3	2.42	0		3	1.43
Reformatory commitment	11	8.72	5	6.85	16	8.16	1	.81	2	2.56	3	1.43
Penitentiary	2	1.63	1	1.37	3	1.53	0		0		0	

*Reference 2, p. 213, Table 12.

earlier monograph report, supplies essentially the same type of information for the subjects of definitely low intelligence (below 70 *IQ*). In reading the two tables it will be necessary to keep in mind two respects in which they are not directly comparable. In the first place the subjects of the earlier study (Table 3) were, on the average, approximately one year older than those of the present study (Table 2); also, their records were examined over a period ending May 1, 1935, as compared with the terminal date of May 1, 1938, here employed. The other particular in which the tables are not exactly comparable is the manner in which "reformatory" commitments have been classified. Reformatory commitment in Table 2 refers to the population of one specific institution—a place of medium security for male offenders between the ages of 16 and 30 years. In Table 3 this type of inmate was included under the reference to "Penitentiary." Table 2 specifies "Industrial school commitment" for juvenile delinquents who comprised the "Reformatory" group of the earlier study (Table 3).

The several classifications in Table 2 involve a certain amount of duplication. Of the 36 males with police court records 15 are included among the juvenile court cases. Nine of the men given

jail sentences had, when younger, been brought before the juvenile court Three of the five reformatory cases had, earlier, appeared on the records of the juvenile court A similar record appears for the one person committed to the penitentiary and to all of the six males listed with the industrial school. In the record of the females, it was found that two of the five appearing on the police records had, earlier, been before the juvenile court; the three committed to the "industrial school" (Girls' Training School) had, similarly, been before the juvenile court as well as had the two sentenced to the women's reformatory.

Among the control subjects, there are five of those with police court records whose names are also listed with the juvenile court This applies, as well, to the three males committed to jail and to the one reformatory case Both women (controls) with reformatory records and the one woman listed with the police court were, earlier, juvenile court cases

Examination of the juvenile court records of the three classifications of subjects, mentally deficient, dull, and normal, reveals some rather significant differences. Whereas from three to four per cent of individuals of "normal intelligence" were listed with the juvenile court as delinquents, there were 9.45 per cent and 25 per cent, respectively, of the dull and of the definitely deficient subjects. The degree of statistical reliability present in these differences is indicated in Tables 4-5

TABLE 4

THE DIFFERENCES IN JUVENILE COURT CASES AMONG DULL AND NORMAL SUBJECTS

Subjects considered	N	%	*Diff*	$\frac{D}{\sigma_{diff}}$
Dull subjects	29	9 45	6 52	3 31
Normal subjects	9	2 93		

TABLE 5

THE DIFFERENCES IN THE JUVENILE COURT RECORDS OF DULL AND OF DEFICIENT SUBJECTS

Subjects considered	N	%	*Diff*	$\frac{D}{\sigma_{diff}}$
Dull subjects	29	9.45	15 55	4 53
Definitely deficient subjects	49	25 00		

Another characteristic of the delinquency among the several groups of subjects is the definite reduction in difference between subjects of the two below-normal classifications when males only are considered. This circumstance is brought out in a comparison of the critical ratios expressed in Tables 5 and 6.

TABLE 6

THE DIFFERENCES IN JUVENILE COURT RECORDS OF DULL AND OF DEFINITELY DEFICIENT MALES

Subjects considered	N	%	*Diff*	$\frac{D}{\sigma_{diff}}$
Dull males	21	13.04	12.98	2.75
Definitely deficient males	32	26.02		

As children the subjects who are designated "dull" appear to have occupied a middle ground between the other two groups with regard to records of delinquency. But the percentages increase for the dull subjects when their adult records are examined. Police court files have 13.35 per cent of the dull subjects listed as compared with 4.24 per cent of the normals and 17.86 per cent of the "subnormals." For the males of the two below-normal groups the differences are statistically insignificant, as indicated in Table 7. A similar situation obtains with respect to jail sentences for the males (see Table 8),

TABLE 7

THE DIFFERENCES IN POLICE COURT RECORDS OF THE MALES OF TWO BELOW-NORMAL GROUPS

Subjects considered	N	%	*Diff*	$\frac{D}{\sigma_{diff}}$
Dull males	36	22.36	2.85	56
Definitely deficient males	31	25.21		

TABLE 8

DIFFERENCES IN RECORDS OF JAIL SENTENCE FOR TWO GROUPS OF BELOW-NORMAL MALES

Subjects considered	N	%	*Diff*	$\frac{D}{\sigma_{diff}}$
Dull males	18	11.18	2.64	66
Definitely deficient males	17	13.82		

and also for the police court and jail records of female subjects Tables expressing these differences are not here given for the female subjects since the differences are clearly not greater than for the males and the numbers (where the females are concerned) are so small

Contrasting the figures for "Industrial school commitment" in Table 2 with "Reformatory commitment" in Table 3 indicates a definitely higher rate of delinquency for the lower-grade, male intelligences Table 9 shows the significance of this difference

TABLE 9
THE DIFFERENCE IN INDUSTRIAL SCHOOL COMMITMENT FOR THE MALES OF TWO BELOW-NORMAL GROUPS

Subjects considered	N	%	*Diff*	$\frac{D}{\sigma_{diff}}$
Dull males	6	3 73	5 19	1 82
Definitely deficient males	11	8 92		

Here again the relative frequencies of delinquency seem to vary with increasing age as the medium security and maximum security commitments for adults are examined Adding the percentages of "Reformatory" commitments and "Penitentiary" commitments in Table 2 shows 2.60 per cent of the dull population institutionalized as compared with 1 53 per cent of the morons of the 1935 study, and a greater difference appears when the males of the two groups are considered · 3 73 per cent and 1 63 per cent respectively While the small numbers involved in the latter two comparisons do not support statistical reliability of the differences, it does seem worthy of note that the dull subjects so consistently increase in relative percentages of delinquency as their ages increase

D. SUMMARY AND CONCLUSIONS

This report has dealt with the conduct records of 307 dull individuals whose careers have been traced over a period dating from the first appearance of their names on the record of the Lincoln Public Schools to May 1, 1938 Comparable data were secured for an equal number of individuals of normal intelligence Further comparisons were made with 206 subjects of definitely lower mentality whose careers were traced in an earlier study

In the last section above there was presented evidence to indicate

that in some respects the conduct record of dull persons is not better than that of individuals of definitely deficient intelligence and that in virtually every respect their adjustment has been inferior to that of persons of normal intelligence. Some of the principal findings may be summarized as follows:

1. There is a marked tendency to more delinquency both among the males and females of the dull group when compared with the normals, the difference being much greater when the records of males only are compared.

2. A comparison of the records of 206 definitely deficient individuals (below 70 *IQ*) with those of the dull group shows that through the 'teen-age period those of lower mental ability were in relatively greater numbers brought before the juvenile court, as well as institutionalized. Nevertheless, the differences tend to disappear as the subjects' ages increase, for the police court records for adult offenders, the jail sentences imposed, and the commitments to penal institutions for adults show quite similar percentages for the two groups.

3. While the delinquency rates for the boys and girls of the "normal" population were virtually equal, there was a marked difference of rates for boys and girls of the dull group, the girls' rate conforming quite closely to that of the normal population with that of the boys bearing more resemblance to the record of the definitely deficient population. The rates were much the same for the two sexes of the lowest intelligence grouping. Just why there should be such disparity between the two sexes of the dull population is not apparent from data now available, but that society does a better job of keeping girls of the duller type out of difficulties with the juvenile court than it does with boys is quite evident.

A fact which may be of some importance in connection with conclusions which the study suggests is that wherever the percentages of delinquency for the dull group approximate those of the lower intelligence population a much larger total of delinquency is being expressed, for the former group was so chosen as to represent a section of the whole population some 10 to 15 per cent larger than that represented by the definitely deficient. Hence the greater significance which should attach to the delinquency rate among dull subjects.

As mentioned in the first section, there is reason to believe that in our schools more effort has been expended in working out plans for

the special room child than for the somewhat better endowed, but nevertheless handicapped, dull child It is not unreasonable to suspect that many such dull pupils have been driven to compete with normals in a school program designed for normal children What such experience has contributed to the anti-social attitudes of dull children can only be a matter of conjecture In any case the present study supplies some support for the idea that attention directed to the causes of delinquency among those persons who are of dull mentality will at least be operating in the area where the numerically largest number of delinquents are recruited

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The Journal of Genetic Psychology, 1939, 55, 381-388

A STUDY OF THE DEVELOPMENT OF INSIGHT IN PRESCHOOL CHILDREN*[1]

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A. BACKGROUND

Historically the work of Kohler with his chimpanzees provides the starting point in the experimental investigation of the problem of insight.

In reporting his work, Kohler made several suggestions for further research with children. These were carried out by Alpert in 1928 and by Matheson in 1933. In her study of problem-solving behavior in preschool children, Matheson employed Kohler's technique "not to make a direct comparison between the behavior of the children and the apes," as did Alpert, but to obtain a "general picture of the solving type of behavior in very young children." This briefly is the background.

B. THE PROBLEM

The purpose of the present research was to observe a group of children between the ages of 18 to 48 months in a problem situation that would reveal not only the degree of insight which is present, but also reveal pertinent responses to permit a developmental analysis of insight.

We have no argument with the statement that the child in a problem situation displays an understanding that may be characterized as insight. Our contention is that methods, for this particular problem, suitable in the realm of animal investigations, fail to meet the needs of a research concerned with human subjects. We are dealing with a more complex organism and as such the approach should be specifically designed to fit the greater degree of complexity.

Before discussing the procedure proper it is important to consider the concept of insight from the standpoint of definition. There

*Received in the Editorial Office on October 13, 1938.

[1]This paper was read at the April, 1938, meeting of the Eastern Branch of the American Psychological Association in New York.

are a multitude of definitions and a variety of meanings which have become attached to the term *"insight."* Consult any text dealing with this topic and the point becomes readily apparent. Some of the difficulties encountered are made clear by G. W. Hartmann in his paper, *"Concept and Criteria of Insight."* We should, therefore, decide upon a definition to meet the requirement of this experiment.

For our purposes *insight shall mean a perception of relations, wherein the child shall fixate specific relationships, and, in the presence of a similar problem, in which the superficial characteristics are altered but the essential features held constant, the child shall select relevant relationships involving the special feature, which will result in solution.*

What distinguishes this study from previous investigations in this field is the introduction of two sets of tools designed to furnish a varying selectivity and a developmental insight-range from "no insight" to "maximum insight" (Figures 1 and 2). Both sets of

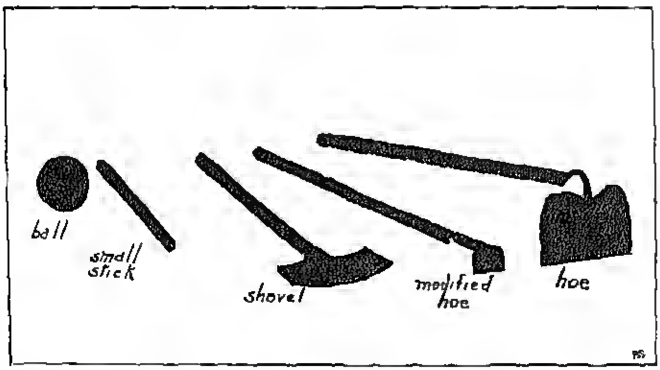

Fig 1 The Hoe Set of Tools

FIGURE 1
THE HOE SET OF TOOLS

tools (five pieces to each) involve the same principles in use, but in the second set (Figure 2) the superficial characteristics have been altered. The varying-selectivity compels the subject to chose one of several possible modes of behavior, thereby eliminating a mere "yes" or "no" response. This forced selection is significant in that it provides a more accurate and complete picture of insight behavior as

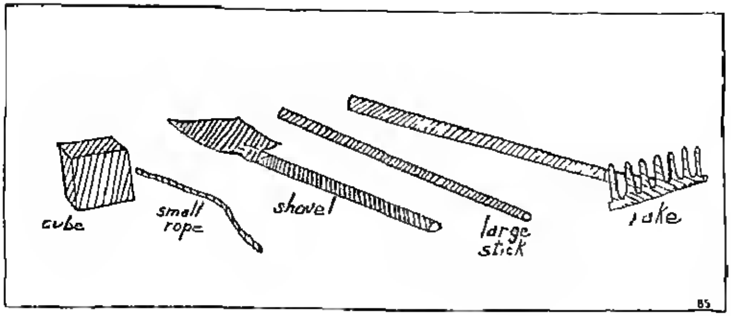

fig 2 The Rake Set of Tools

FIGURE 2
THE RAKE SET OF TOOLS

well as the fact that it makes place for a comparison that is not possible in a one- or two-tool situation in which instance there is but one required reaction Another factor against the one- or two-tool situation is that little evidence of the nature of the response is made available, since the presence of only one or two tools tends to limit the response of the subject

Consider the insight range of our tools. For example, the *Hoe Set* (Figure 1) The ball has no insight value for this particular problem It cannot be used to acquire the incentive (A group of 5-and-10-cent store toys, dolls, autos, dogs, horses, cats, etc.—all miniature in size, provided the incentive factors) The subject, in using the ball, reveals a lack of understanding of the principle involved

The small stick has a minimum of insight value Manipulation of the small stick toward the incentive is a step in the correct direction. Such a response embodies a portion of the principle involved in acquiring the incentive.

The shovel possesses a partial insight value This instrument can be so manipulated as almost to secure the incentive.

The modified hoe has intermediate insight value Using this tool, the child can obtain the incentive but not as easily as he could by employing the hoe

The hoe has maximum insight value for our problem situation With it, the incentive can be most readily acquired

The same values apply to the *Rake Set* of tools (Figure 2), which consists of a cube, a small rope, a shovel, a large stick, and a rake

The *Hoe Set* was painted blue, the *Rake Set* orange In this way the color factor for each set was kept constant

The tools were manipulated on an adjustable table (Figure 3)

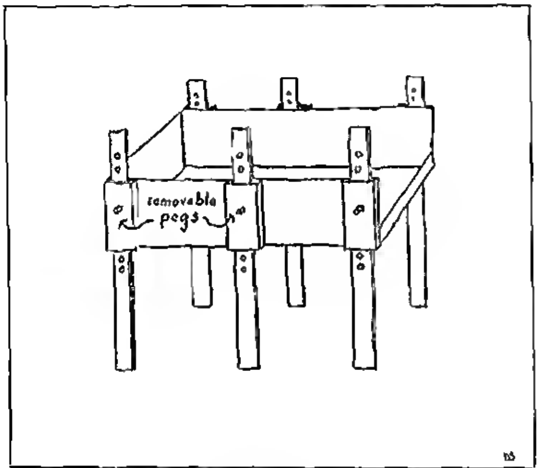

FIGURE 3
SIDE VIEW OF THE ADJUSTABLE TABLE

30" in width and 40" in length The height of the table was variable, depending on the individual child, and fixed by a series of pegs, just below the child's armpit to facilitate reaching, but to prevent leaning over the table This adjustable table permitted a real-life approach to the problem situation in contrast to the restricted play pen set-up of previous investigations Here, the child's vision was not blocked by the bars of a play pen, nor were his movements confined to the size of a play pen

C Subjects

Twenty-six children observed in the Wayside and Bryson Day Nurseries in New York City provided the material on which the results of this paper are based

D Procedure

When a child was first brought into the test room it was led to the table Its reach, plus the length of the hoe or rake (20" each—the longest tools of each set) was measured so that the incentive would always be placed a constant distance from the edge of the table for each subject Then the child was shown the *Rake Set* in an introductory 30-second period, and was asked to identify the tools if he could A toy was placed on the table and the child was simply told to *"Get it!"*

Theoretically, the question arises: *"How do we know that the child when presented with the Rake Set in the first transference situation would not select the rake first anyway?"* In answer to this question, the *Rake Set* was used in the 30-second introductory period in which the subject sees the set-up for the first time

After the introductory period, the *Rake Set* was removed from sight and the *Hoe Set* placed on the table Familiarity with the tools seemed to be a small factor in initial activity

At the first sign of diminishing interest a new incentive was placed on the table. Incentives were changed frequently and an attempt was made always to provide the toy to which the child responded most readily

Four other series were arranged The first two, using the *Hoe Set,* constituted what we called the *Fixation Series* The remaining two, using the *Rake Set,* constituted the *Transference Series.*

Five successful trials were required in the first fixation series with the *Hoe Set* before the subject proceeded to the remaining series. In each new trial the positional factors were controlled by constant variation of the placement of the tools The possibility that the child reacted to color rather than to the tool was eliminated since the color factor is constant within each series

The second fixation situation required only one successful trial. This was to prevent over-fixation The tools of the *Hoe Set* were reversed so that the blades of the hoe, the modified hoe, and the shovel faced the child The subject was required to select the hoe, turn it about, and use it to secure the incentive

The *Rake Set* was then substituted for the *Hoe Set* In an attempt to control such features as the angle between the blade of the tool and the handle to which the child might be reacting, or features such as similarity in shape and position, the rake was reversed

and turned, with the rake-teeth up (see Figure 2), facing the child. The rake was used in this manner throughout the experiment. Five successful trials were required. In the remaining transference situation, the *Rake Set* was removed from the table and placed on the floor, behind the child. Five successful trials were required.

E. Results

The observed material was divided into a *Fixation Group* and a *Transference Group*. By *fixation* was meant the ability of the subject to select the specific feature, that is, the correct response, and carry it to a constancy, i.e., complete the required successful trials. Fixation may occur at first sight (*Immediate Fixation*); or a short while after the child was presented with the problem (*Intermediate Fixation*), or it may develop slowly after several exposures to the situation (*Gradual Fixation*), or it may take place partially (*Incomplete Fixation*); or never at all (*Failure to Fixate*), depending on the child.

By *transference* was meant the ability of the subject to select the specific feature in a new situation, similar to the fixation with the exception that the superficial characteristics had been altered. Transference was considered as the determinant that indicated whether the subject had simply acquired a reaction to a particular stimulus, or whether he had insight into the relationships involved. Transference, as *fixation*, occurred immediately, intermediately, gradually, incompletely, or not at all.

There were several interesting cases among the results that clearly showed the significance of this type of approach in providing a more adequate means of interpreting insight behavior as well as being specifically suited to meet the more complex needs of the subjects. For example, some children displayed a type of response that may be called *"complete insight"* if it were judged on the basis of the initial fixation situation alone. Taking into account the performance in the transference situation, however, showed the responses of these children thoroughly lacking in insight characteristics. The converse was also noted where the child appeared to be learning by trial-and-error in the fixation series, but, in the test situations, demonstrated *Immediate Transference,* or complete insight.

It is our opinion that these are interesting findings especially in relation to Kohler's technique as utilized by Alpert and Matheson.

Here, we have two types of response One, in terms of Kohler's technique, would be called complete insight, while actually the test situation revealed a failure to grasp the relationships involved The other type, on the basis of our fixation series alone, would be called partial insight, while actually the transference series indicated complete insight in relation to the principles involved

To summarize some of our other findings

(1) All degrees of Fixation and Transference were observed in all the groups (Four age levels were considered Group I, 18 to 24 months Group II, 25 to 30 months. Group III, 31 to 36 months Group IV, 37 to 48 months) Gradual Fixation and Gradual Transference predominated in the two younger groups Fixation occurred more rapidly in Groups III and IV than in Groups I and II. In the older groups a greater degree of Fixation and Transference existed as compared to the younger groups

(2) Four general types of behavior were discerned in tracing the effects of the first hoe situation on the series that followed, and the effect of the observed changes on insight: (*a*) Excessive manipulation, (*b*) relearning, (*c*) facilitated responses, (*d*) inhibited responses In (*a*) the tendency was to respond mainly to the tools per se In (*b*) the subjects did not seem to grasp relationships involved and reacted to a particular aspect In the transference situation they would merely relearn This tendency hindered the development of insight In (*c*) the previously fixated behavior produced such an effect that the subject tended to react with insight behavior in the test situations In (*d*) the previously fixated behavior produced effects that were the exact opposite of those in (*c*); the tendency was to "block" the abstraction that was necessary for insight

(3). A difference was observed in the relative motivation of the tools and the incentive. For the younger children, principally during the first trials, the tools tended to be more motivating than the incentive As the experiment progressed, however, the attraction of the tools decreased until the toy became the chief motivating factor. In the case of most of the older children, the tendency was to respond to the incentive The tools per se did not attract them; it was rather the adequacy of the tools as a means of securing the incentive that interested the child.

(4). Comparing one age group to another would seem to indi-

cate that those children who possessed knowledge of the names of the tools produced better results in terms of degree of fixation and transference. Within the same age group, however, the ability of the children to identify the tools used was not essential to fixation and transference. Results within the group were comparatively the same whether the subject named the tools or not. The ability to name the tools did not mean that there was a tendency on the part of the child to display preference for the tools named. Rather, the converse seemed to be more often the case.

(5). The results obtained, as judged in the light of previous studies in this field, emphasize the importance of transference as a criterion of insight. The introduction of the transference series in this study has tended to reveal that some of the responses in the fixation situations that ordinarily would be classed as insight behavior failed to reveal such characteristics when further experimentation was carried out.

Summing up, it must be kept in mind that the primary concern of this research was "how" and "when" insight developed, rather than whether it exists, completely or in varying degrees. At the present, however, the results of this experiment do not permit generalizations regarding pertinent responses that lead to a development of insight. This study is of significance in that it has indicated the age level, namely 18 to 33 months, at which we may hope to find pertinent responses to allow a developmental analysis of insight with an experimental set-up such as here described. Further study utilizing this method with additional refinement of techniques and a larger number of subjects at the age level indicated is now in preparation. Its findings should be fruitful in providing a clarified and more adequate understanding of the nature and development of insight in young children.

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The Journal of Genetic Psychology, 1939, 55, 389-400

STUDIES IN ANIMISM I A STANDARDIZED PROCEDURE FOR THE INVESTIGATION OF ANIMISM*

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Piaget in his studies of child thought has persistently employed a method of clinical examination " . which claims to unite what is most expedient in the methods of test and of direct observation, whilst avoiding their respective disadvantages " (4, p 7) However, the clinical method is subject to the great disadvantage of lacking a standardization of this procedure, and this lack makes direct comparison from individual to individual and from investigator to investigator of questionable significance Piaget believes that standardization of the method cannot be achieved for he claims that " . . it is, in fact, impossible to observe a large number of children under similar conditions ." (4, p 6) in such a manner as to permit a satisfactory analysis of the concepts of the individual child

A challenge of this sort can be met only by exhibiting a standardized procedure and attempting to show that it is adequate to research needs The present paper presents a procedure which has been used in a series of studies of the animistic concepts of children The procedure is the result of considerable trial and error on our part, and it has also benefitted immeasurably by the suggestions, examples, and discussions contained in Piaget's *The Child's Conception of the World* We do not insist that our procedure will answer all purposes However, it enables one to classify children into the four stages of animism which are outlined by Piaget, and by so doing it permits an objective study of factors associated with the development of animistic concepts [1]

The method consists of a series of questions presented under controlled conditions in a standardized manner and it involves standard-

*Received in the Editorial Office on November 21, 1938

[1]The writers are indebted to the School Department of Worcester, Massachusetts, and in particular to Miss Marble, primary supervisor, Miss Killilea, principal of the Freeland Street School and the teachers of Freeland and Cambridge Street schools for their cooperation during the progress of the experiment

ized directions for the classification of answers. It allows for the presentation of the same experimental situation from subject to subject and makes possible the repetition of the experiment. At the same time it is similar to the fruitful methods employed by Piaget in that it does not impose answers upon the child and, beyond certain fixed questions, it permits the examiner to vary his questions in accordance with the responses of the subject

The method as here described deals solely with child animism, but the possibilities of its extension to other fields of child thought are readily apparent.

Dennis (1) has sketched the treatment of animism prior to the twentieth century and has pointed out that "The recent rise of laboratory psychology has been accompanied by a loss of interest, and often by a loss of information, in respect to certain older problems" (1, p 257) Recently Piaget (4, 5) has aroused a new interest in the study of child animism by showing that tendencies among children " . to regard objects as living and endowed with will" (4, p 17) follow a certain systematic course which enables the experimenter to classify any given individual as being in one of four developmental stages. Children in the first stage consider anything as living which is of some use or is in good condition, i.e , not broken, damaged, nor separated from its normal context. In the second stage anything that moves is considered living This is in contrast to the more restricted third stage in which the child distinguishes spontaneous movement from movement imposed by an outside agent, life being identified with spontaneous movement In the fourth or adult stage life is restricted either to animals or to animals and plants

Subjects

A total of 385 subjects were examined by means of the standardized procedure They were enrolled in the Cambridge Street Nursery School and in the Freeland Street Primary School in Worcester, Massachusetts, a city of approximately 200,000 inhabitants Those examined comprised the complete enrollment of the two schools and were distributed about evenly among the various grades. The range in chronological age was from 3 years 0 months to 15 years 6 months The majority of subjects came from lower middle class homes, and from English-speaking parentage

After the examinations were completed the subjects in the primary school were given Kuhlmann-Anderson *Intelligence Tests* in order to determine the normality of the group The median IQ was found to be 106 05±9 00 with a range from 75 to 139 From the normality of the distribution and the close approximation of the median IQ to the theoretical median IQ of 100 the writers feel justified in concluding that the group under study was a representative one as regards mental ability

Each grade was divided into two groups, namely a group which entered the grade in February and another composed of those who entered in September Those children who entered each grade in September were arbitrarily chosen for re-examination The number re-examined was 133 No nursery school or kindergarten pupils were re-examined, i e, the re-examinations were conducted only in the primary school The re-examination occurred in each case one week after the original examination and care was taken that only the two experimenters were acquainted with its nature, purpose and date of administration

Procedure

Each subject was questioned individually in a small room set aside for the experiment The questions concerned the animate or inanimate nature of a series of objects which were chosen with a view to determining the position of the child in the scale of animistic concepts The 20 objects selected we believe to be among the most universally familiar objects which can be used in the study of animism The position of each object in the series may be seen in Table 1 The first eight objects were present in the room, all of these except the chair and watch being displayed on the experimenter's table The remainder were referred to verbally, or, as in the case of the clouds and trees, by pointing to them as seen through a window.

The subject and the experimenter were seated at opposite sides of a table or a desk and the objects previously referred to were scattered over the surface in what appeared to be a random arrangement but which actually aided the experimenter in following the prescribed order of presentation

Every effort was made to eliminate the artificiality of the situation. The subjects were made to feel that they were playing a

TABLE 1

List of Objects in Serial Position of Presentation*

1	Stone	11	Moon
2.	Knife	12	Wind
3	Mirror	13	Lightning
4	Button	14	Pencil
5	Comb	15	Dog
6	Chair	16	Bird
7	Dish	17	Bug
8	Watch	18	Tree
9	River	19	Flower
10	Clouds	20	Grass

*A round, smooth stone was used The knife and comb were of the common pocket variety The mirror was of the type found in a woman's vanity or in a small wall frame. The button, a common coat button, and the dish, a china bowl, were broken or chipped in an attempt to render them useless in the opinion of the child The chair was straight-backed, of the type used in school study rooms The watch was either a wrist-watch or a small pocket watch and the pencil, an eversharp

When speaking of the tree, flower, or grass the experimenter phrased the preliminary question in accordance with the season of the year If the plant referred to was green, the question was phrased as, "Is the —— living or dead?" But during the winter months, the question was presented as follows "Is the —— living or dead *in the summer?*"

game, or that they were aiding their friend, the experimenter, by answering the questions carefully No examination period ever continued for more than 15 minutes at a time.

After rapport had been established the following instructions were given

> We are going to play a game I am going to ask you some questions and we will see how many you can answer You know what living means? A cat is living but if an automobile runs over it, it is dead

These remarks were found necessary as a means of acquainting the child with the nature of the questions to follow

After these preliminaries the actual questioning began For each object the questions asked were *"Is the —— living or dead?"*, and, *"Why?"* The responses were recorded in sufficient detail so as to render them available in full for later classification These two questions were the same for all twenty objects with every subject studied Any additional questioning concerning a given object depended upon the subject's responses to the first two questions and was deemed necessary only when the first two responses were not clearly intelligible.

After considerable trial and error it was discovered that only two additional questions were necessary to obtain the extra data desired. The first of these was asked when a subject said that a given object was dead because it did not move. The experimenter then moved the object if possible or in any case asked, *"Is the ——— living or dead when it is moving?"* The question was raised in order to determine whether, in the subject's opinion, imparted motion or spontaneous motion was the criterion of life. This question was never asked, however, until the subject himself suggested motion as a criterion of animation.

The second supplementary question also concerned the differentiation between Stage 2 and Stage 3. If an object was said to be living because it moved (or ran, or ticked, etc.) and it was not clear whether spontaneous or imparted movement was meant, the subject was asked, *"Can the ——— move by itself or does something move it?"*

The answers to these supplementary questions coupled with the answers to the primary questions served to classify an individual definitely.

The youngest subjects sometimes gave evidence of perseveration and sometimes answered at random. With these cases the list was repeated and the questions changed from *"Is the ——— living or dead?"* to *"Is the ——— dead or living?"* It should be emphasized that perseverative answers and answers at random were noted only in the case of subjects in the *No Concept Stage* where the child was responding in the absence of any definite concept of the animate and the inanimate.

Another instance in which the list was repeated occurred when the subject gave what appeared to be contradictory answers on the initial presentation of the list. For example a child might say that the river is "living" because it moves, but on the succeeding question say that the clouds are "dead" because they move. In a case of this kind the experimenter after completing the first presentation repeated the list or the parts of the list where the contradiction occurred and noted whether the subject corroborated or refuted his previous answer. It was usually found that the contradiction disappeared on re-examination of the confused subject.

The Type of Response

It has been suggested that, in general, there are five types of reactions revealed by the clinical examination of children (3, 4). We might expect to find all of these various types represented under the conditions of the present experiment and, if the method is of value, it must provide some means of either controlling the undesirable reactions or, at least, of segregating them out

In the first place, the "answer at random" type of reaction seems to appear when the child is uninterested in the question asked and replies in a haphazard fashion or when he is incapable of giving systematic and coherent replies to the questions The answer at random, when it is the result of lack of interest, may be remedied by a skillful control of motivation. In the present investigation the authors found that the younger children cheerfully anticipated playing a new game and that the older subjects were very much interested in this queer, new-type test Reactions to the examination after its completion revealed that the interest in it was even more than a momentary matter Many remarked that the test was "hard" and wanted to know what the examiners intended to do with it. At no time did the experimenters feel that the answers revealed a lack of interest and a careful study of the records failed to reveal any "haphazard" replies from those subjects who were classified as having a concept However, children who had to be classified as having no acquaintance with the terms "living" and "dead" necessarily gave random answers, nor could any procedure be expected to remedy this situation

Secondly, "romancing" is a type of response in which the child answers without reflection, inventing an answer which he does not believe or believes merely by the force of repeating it No such answers were detected in the data of these experiments Two cases of this type were observed, but both these children were removed from school before the experimentation was completed Instances of answers of this nature occurred more frequently among the feeble-minded children studied by Dennis, Ash, and Russell (2). There may be some significance in the fact that most of the subjects who gave such answers had been diagnosed as pre-psychotic

A third type of reaction has been termed, "suggested conviction" In this instance the child attempts to answer the question by giving the response he believes the experimenter wishes or by answering

a suggestive question without trying to think for himself. The obvious answer to this is that the experimenter must refrain from any actions that might be at all suggestive. On the surface this would seem a rather difficult thing to control. However, if the experimenter follows the test procedure closely, there is very little chance that suggestion will enter into the questioning. If it be objected that the subjects answer merely to please the examiner, it may be pointed out that in giving answers the subjects reveal a series of concept stages. Since the examiner's procedure remains fixed, it is scarcely possible to attribute several types of suggestion to him.

If the subject responds after reflection and without suggestion, the response is considered as a "liberated conviction," and, if the subject responds immediately, having already formulated, in his past experience, an answer to the question, the result may be classified as "spontaneous conviction." Obviously these latter two reactions are of the greatest value in our study and, since the former three reactions have been found to be absent or inconsequential we propose that in our study the liberated and spontaneous convictions are the ones with which we are dealing. For our purposes it is not important to distinguish between these two kinds of responses and therefore no attempt has been made to do so.

The Principles of Classification

In classifying a subject it is essential not merely to consider which objects the subject declares to be living, but also to take into account the subject's information about the object and his interpretation of the object's behavior. An example is perhaps in order. A subject in Stage 3 may think of clouds as stationary objects and therefore "dead" because they do not move. On the other hand he may think of them as *moving objects*, but *inanimate* because movement is imparted by the wind. Still a third possibility would be to think of the clouds as moving of their own accord and therefore "living." Depending on the subject's information and interpretation, any of these three answers is characteristic of Stage 3. The important point is that the subject discriminate the animate from the inanimate on the basis of a consistent principle, i.e., use, movement, etc. Individual answers are considered consistent or inconsistent from the point of view of the subject's information and his interpretation of that information.

If there is no apparent principle reflected in the subject's answers, if his only response is "I don't know," if he gives no answer whatsoever, or if his replies are contradictory he is classified as being in the *No Concept Stage*

To the child in Stage 1 of animism everything that is useful or in good condition is alive. Therefore all 20 objects may be considered as animate depending upon the subject's interpretation of which objects are useful and which are in good condition Usually the button and the dish are considered "dead" because they are broken and of no use, while the majority of other objects are classified as "living" However, the dish may be said to be still useful as a scraper or scoop and hence living When an individual child's answers conform to this type of concept he is classified as being in Stage 1

Subjects in Stages 2 and 3 are recognized by the fact that they give motion as the basis of their discrimination between the "living" and the "dead" In this respect Stages 2 and 3 are alike In order to distinguish between these concepts the answers to the supplementary questions must be referred to. If "motion," without regard to its spontaneous or imparted nature, forms the guiding principle in the subject's discrimination he is considered as belonging in Stage 2

Subjects in the Stage 3 concept differentiate spontaneous from imparted movement To live is to move of one's own accord In order to classify a subject as being in Stage 3, one must know not only which objects the subject considers to be living and which objects he considers to be dead, but one must also take into account the answers to the supplementary questions which show what objects are thought to be spontaneously active Thus, as was previously noted, a subject who is in Stage 3 may consider clouds to be either living or dead, so long as he adheres to spontaneous movement as his criterion of life As indicated earlier it is possible for him to declare them dead because he thinks they do not move of their own accord, or he may state that they live because they can move at will It is important to note that either answer is fully in accord with the definition of Stage 3

The last six items in the series furnish evidence for the placement of subjects in Stage 4. In this stage life is restricted to animals alone or to plants and animals. Obviously Items 1 through 14 are considered dead by Stage 4 subjects

At this point it should be noted that exceptional cases do occur,

although they are extremely infrequent, in which a child employs a definite principle in distinguishing the animate from the inanimate, but which principle differs entirely from those used in Piaget's classification A striking example of this was found by Dennis, Ash, and Russell (2) in the study of animism among feeble-minded children when one subject distinguished between "living" and "dead" on the basis of whether the object in question was in a horizontal or vertical position. Cases of this kind have been classified as "special cases"

The Reliability of the Classification

The classification of the subjects into stages on the basis of their recorded responses was accomplished independently by three judges, one[2] besides the authors

The results in the classification of the initial examinations showed that Judge *A* agreed with Judge *B* in 97 per cent of the cases, Judge *A* agreed with Judge *C* in 88 per cent of the cases; and Judge *B* agreed with Judge *C* in 89 per cent of the cases. There was unanimous agreement in 87 per cent of all the cases.

The necessity for experienced judges is forcefully presented when Judge *C*'s record is compared with those of Judges *A* and *B*. Judge *C* was relatively unfamiliar with the procedure at the time of his first classification The principles of testing emphasize the fact that a thorough acquaintance with test procedures is necessary if the results are to be considered valid The same qualification holds for the classification of data resulting from standardized procedures if the final interpretations are to be of consequence

In contrast to the original classification, classification of the re-examinations showed a unanimous agreement of the three judges in 94 per cent of the cases Judge *A* agreed with Judge *B* in 96 per cent of the cases, Judge *A* with Judge *C* in 95 per cent, and Judge *B* with Judge *C* in 94 per cent.

Those cases in which there was disagreement were classified later by common consent In the discussion which followed the initial classification, interpretations of the recorded responses in question were brought out which made it apparent that, in the final analysis, the three judges were in complete accord

On the first examination there were four instances which were

[2]Mr Elton Ash, a graduate student in Psychology at Clark University.

classified by the judges as "special cases", that is, only four subjects had a systematic distinction between the animate and the inanimate which did not accord with any of the four stages This means that aside from the cases which were classified as having no concept, of which there were 35, 346 of the remaining 350 cases could readily be classified as being in one of Piaget's four groups In the re-examination only two "special cases" were found.

THE RELIABILITY OF THE SCALE

In connection with the question of reliability, the conception of animism as a dynamic developmental process must be taken into consideration It is possible that the child's ideas of the animate and the inanimate undergo many changes between the time when they first become organized (Stage I) until the adult concept is reached The examination of pre-adult-stage subjects must take place, therefore, during this development and it is perfectly possible that any child may advance one stage or possibly more than one stage between the original examination and the re-examination It is also possible that a child may temporarily acquire a more advanced concept and yet again revert to the more primitive one Under these circumstances, we might expect the child to regress in his ideas from the original examination to the re-examination Therefore differences between examination and re-examination may be due not merely to "unreliability" as ordinarily conceived, but also to genuine changes in the child's ideas An analysis of the data of the 133 re-examinations shows that 18 per cent of the subjects advanced on their retest, 9 per cent regressed and 73 per cent remained at the same level Despite the possibility of changes on the retest due to developmental influences, the coefficient of Mean Square Contingency for the results of the two examinations was found to be 0 81 Yule (6, p 66) has pointed out that with a 6 x 6 contingency table the coefficient cannot exceed 0 91

The question next arises as to the effect of the original test on the retest In the first place, the original questioning might serve as an educative influence in itself It might crystallize the problem for the child and stimulate additional thinking concerning the animate and the inanimate. Analysis of the 133 subjects tested and retested revealed the fact that of those in Stage 1 on the original test

16 per cent advanced on the retest, of those in Stage 2, 26 per cent advanced, and, of those in Stage 3, 17 per cent advanced

In this same regard the questions of coaching and familiarity with the test material should be considered The cooperation of the teachers was solicited in order to prevent any coaching in school The study of gender was postponed until after the testing was completed However, the possibility of coaching outside of school was uncontrollable The examiners did ask subjects with brothers or sisters in the school not to tell them what occurred during the test period on the pretext of wanting to see how well the brother or sister could do in comparison with the subject It is definitely known, however, that in a small number of cases the subject was apprised of the general nature of the test prior to taking it It is interesting to note in this regard that subjects who stated that they "knew" the test were only familiar with the very general instructions This is in agreement with experiments in the psychology of testimony which have demonstrated that children's ability to report upon a set of experiences is extremely weak A few of the items used in the questioning might have been remembered, but never throughout the experimentation was there actual evidence that coaching was exerting a significant influence on the subject's reports.

It might be argued that a knowledge of the general instructions alone would prove sufficient for coaching by parents The chief evidence for the fact that this was not a significant variable lies in the fact previously mentioned that of all the subjects tested and retested only 18 per cent advanced in the retest over the original test, while 73 per cent remained the same (9 per cent regressed)

Summary

A standardized method has been described which makes it possible to classify children into the four stages of animism which are outlined by Piaget and, by so doing, permits an objective study of factors associated with the development of animism Precautions have been taken to guard against the discrepancies arising from subjective classification of responses obtained by the method

Three hundred and eighty-five subjects ranging from the nursery school to the eighth grade were questioned individually by this method and 133 were re-examined a week later On the first examination all but four and on the re-examination all but two of

the subjects who showed evidence of clear-cut concepts fell into the four stages of animism as defined by the experimenters

The examinations were classified by three judges working independently. The judges' classifications were in unanimous agreement in 87 per cent of the original examinations, and in 94 per cent of the re-examinations The difference suggests the importance of experience for securing reliable classifications.

Despite the possibility of changes on the re-examination due to developmental influences the Coefficient of Mean Square Contingency for the examination-re-examination scores was found to be .81 (with a 6 x 6 contingency table the coefficient cannot be expected to exceed 0 91).

The authors suggest the possibility of extending this method to other fields of child thought.

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The Journal of Genetic Psychology, 1939, 55, 401-413.

THE RELATIONSHIP BETWEEN SURFACE TEMPERATURE AND SOCIAL TRAITS IN YOUNG CHILDREN*[1]

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A. INTRODUCTION

The primary purpose of this investigation was to discover the significance of surface temperature with reference to social traits in preschool children. On an a priori basis one would expect to find some significant relationship. Darrow (9) and Jones (12, 13) both have found certain correlations between personality traits and such physiological measures as galvanic resistance and blood pressure. To obtain either a galvanic or blood pressure measurement on small children is difficult, not only because of the kind of attachment necessary, but because of the emotional attitude of children toward this kind of instrumentation. Since the amount of perspiration is related both to galvanic resistance and surface temperature, and since blood pressure is also a factor involved in surface temperature, one can reasonably expect some sort of direct relation between surface temperature and social traits. An investigation might reveal not only a more exact relationship, but relations of a different kind. If, however, the significance of surface temperature with reference to social traits is of the same order as between social traits and other physiological measures, surface-temperature measurements, due to the ease of attainment, would be advantageous.

B. PROCEDURE

The apparatus used to measure the surface temperature was a thermo-electrical Tycos instrument (21) called a "Dermatherm."

Modal ratings, taken from ratings by two nursery school teachers and the experimenter, were obtained by the use of the *Merrill Palmer Personality Chart* (27) and the *Merrill Palmer Personality*

*Recommended for publication by M. M. White, and received in the Editorial Office on December 1, 1938.

[1]This study was done at the University of Kentucky, under the direction of Dr. M. M. White.

Rating Sheets, and were transposed into Merrill-Palmer percentile scores for the various social traits Stanford-Binet intelligence test scores were also secured from the files

The subjects used were 19 children divided as follows three boys, neighborhood playmates, ranging from 50 to 63 months, eight girls attending the University of Kentucky Nursery School, ranging from 40 to 44 months, and eight additional nursery school children, six months later, consisting of two boys and six girls, ages ranging from 35 to 44 months.

In view of its newness in psychological research, it was necessary for our purpose to conduct some preliminary study regarding the adequacy of the instrument, and the reliability of its measures. Preliminary procedures of investigation were therefore divided into two parts, Part I concerned with degree of adequacy of the instrument and the emotional receptivity of small children to it, and Part II dealing with the reliability of the measures, the constancy of surface temperature, and determination of suitable surface points for indicating individual differences Parts III and IV, the formal aspect of the investigation, were devoted to (*a*) the study of the relationship between surface temperature under relaxed conditions and ratings on social traits in preschool children, and (*b*) checking the findings found in Part III, with further study of surface temperature relationships to specific emotional situations.

1. *Adequacy of the Instrument, Part I*

The three boys were summoned hourly from outside play, from nine o'clock A.M. until noon on two consecutive days for a series of readings as follows. Right and left surfaces each of temples, thorax, back of hands, thighs, instep, and base of great toes Surfaces of palms and soles were not measured in view of Darrow's (7) findings that these areas are concerned with a function other than that of heat control The "Dermatherm" was allowed to stabilize in temperature for one hour preceding the first set of readings, subsequent to which the water in the bottle was left unchanged

The results with these subjects showed a continuous drop in temperature of the constant junction, which led to the sealing of a two-volt light bulb within the thermos bottle. After this adjustment had been made, it was found that a constant temperature could be maintained in the bottle—allowing for an initial warming-up period.

Thus the necessity for reference to the thermometer for the constant reading could be dispensed with. Definite gradients of temperature from body and head portions to the extremities were observed, the coldest temperature inclining toward toes and feet, and next coldest toward the hands (Table 1)

TABLE 1

MEAN SURFACE TEMPERATURES IN DEGREES CENTIGRADE, REVEALING GRADIENTS FROM BODY TO EXTREMITIES

Surface measured	Subjects X	Y	Z	Mean
Right temple	32.7	31.9	32.3	32.3
Left temple	32.7	31.8	32.4	32.3
Right thorax	32.8	32.0	32.5	32.4
Left thorax	32.9	32.0	32.6	32.5
Right thigh	32.0	31.6	31.0	31.5
Left thigh	32.1	31.6	31.0	31.5
Right back hand	31.6	31.4	30.0	31.6
Left back hand	31.6	31.5	29.9	31.0
Right dorsal foot	30.9	31.0	29.8	31.0
Left dorsal foot	30.8	31.1	29.8	30.6
Right toe	30.6	31.0	29.5	30.6
Left toe	30.6	30.8	29.36	30.4

Temple readings were lower than the thorax readings, but clothing covering the latter regions doubtlessly affected this comparison Right and left regions were very closely related. The boys' reactions to this experiment were quite favorable, although the time consumed seemed too long to them in view of rival out-door interests

2 *Reliability of the Instrument, Part II*

After one hour's adaptation to a room temperature of 20.5° C, two nursery school subjects, with shoes and hose removed, were given a series of right and left readings of the following points Temples, thorax, back of hands, and dorsal feet Each point was measured 21 times consecutively for two days, each sitting occupying about 30 minutes Readings disclosed that skin surface temperature crept consistently upward after six or seven readings Comparing the first seven readings with the last seven, it was observed that all medians showed an increase from 0.2° to 1.9° C, and an increase in median deviations from 0.02° to 0.16° C The fact that symmetrical points showed a high degree of agreement indicated the probability that the increased readings secured from repeated contact of a single

point may have been due to a true change in temperature of that region. Probably the successive applications of the junction against the skin resulted in irritation and consequent increased vasodilation in that area. This rise in temperature was also found by Helson and Quantius (11) on successive applications.

The correlations between right and left readings on all surfaces ranged from 0.93 to 0.96, average differences between left and right readings ranging from .03° to .16° on the first day and from 0.03° to .12° on the second day. The standard error of the difference ranged from 0.066 to 0.1. A comparison of the thoracic readings with the other readings indicated that covered portions of the body are of a higher temperature than are uncovered portions, which is in agreement with other studies (21, p. 99). Considering only bare surfaces, however, we found a distinct gradient from upper portions of the body to the extremities.

In review, the results of Parts I and II indicate that: The "Dermatherm" is reliable, variations in experimental technique account for no more than 0.16° C., and that the repeated measurement of the same point should not exceed six or seven times.

Since measurement of both sides was only to provide a check on accuracy, and since the readings of right and left corresponded, only the right-sided readings are evaluated in the two experiments which follow.

3. *Surface Temperature under Relaxed Conditions and Social Traits, Part III*

This aspect of study, limited to six girls, to exclude sex differences, was obtained under the following conditions: For 18 days at 11:20 o'clock, while the children relaxed on their rugs awaiting lunch, measures of right and left temples, and right and left dorsal hands were taken. Room temperature was maintained at 20.5° C., to which the girls were adapted for one hour before the experimental period. An attempt was made to secure approximate relaxation by the children for five to ten minutes before measures were taken. The subjects seemed to have a happy attitude toward the experiment throughout. The fact that there was some rivalry for the distinction of being the first to relax and thus "the first to be measured," served as a crude but fairly effective incentive for the purpose of the experiment. To prevent restlessness, each operation was made as

short as possible Since preliminary experimentation revealed the adequacy of temple and hand measures for obtaining a gradient, only these two surfaces were investigated in this section of experimentation. By so doing, the time taken with each child occupied only about four minutes, which did not at any time appear taxing Thus, the readings for all six children could be taken in a period of 25 minutes, which proved an advantage in the control of activity and of stimulating conditions During the readings, further relaxation was induced by one of the nursery school teachers who read a non-exciting story, sang, or played the piano softly Outside weather conditions were recorded for each day for possible interpretations of surface temperature Temperature gradient scores were determined by dividing temple temperature by hand temperature and multiplying by 100 In addition, internal temperatures, taken by mouth each morning, and Stanford Binet intelligence scores were included in the treatment of the data

4 *Duplicate Experiment and Surface Temperature with Reference to Specific Emotional States, Part II*

This aspect of study, data for which were collected during the following semester on an additional eight subjects, for checking purposes, involved surface temperatures during relaxation, secured in the same manner as were those in the preceding portion of the investigation To determine the reliability of the rankings by teachers and experimenter on emotional control, the subjects were rated both before and after the two weeks' period of study, using again the *Merrill-Palmer Rating Blanks* These children were observed daily from 8 30 until noon over a period of two weeks for tabulation of all emotional episodes, and were subjected to hourly temperature readings under non-emotional conditions Readings were made after emotional episodes concerned with "deprivation of a toy" in order to make the situations comparable These latter readings were limited to those closely following the hourly readings taken during non-emotional states, so that the readings could be justifiably compared Emotional reactions were defined as "crying," "spitting," "leaving the group in anger," "angry speech," etc Emotional control was defined as "calm acceptance when thwarted," "quiet and brief unpleasant facial expressions," "controlled persuasion," etc

C Results

1 Surface Temperature during Relaxation

The correlation between temple and hand temperatures was 0.57. Mean deviations for temple temperatures ranged from 0 41 to 0 93, whereas those for the hand were from 0.7 to 1.7. Although room temperature was held constant, outdoor temperature correlated 0.44 with temple readings (*PE* 0 049) and 0 36 with back of hands (*PE* 0 06). There was some indication that the temperature of the hand is more affected than that of the temple by factors extraneous to weather conditions, inasmuch as the mean deviation of the former was greater and its correlations with weather changes was lower The greater relative variation in hand temperatures corroborates Maddock and Collers' (17) conclusions that the "regulation of the shift of blood is largely to and from the extremity surface rather than simply the surface of the body in general "

2. Back of Hand and Social Traits

Table 2 shows the relationship between mean back of hand

TABLE 2
Right Back Hand Temperature (Degree C) and Merrill-Palmer Percentile Scores on Social Tendencies

Subject	Mean temperature	*AD*	Sociability	Social adjustment	Emotional control	Attractive personality	Effective energy
A	30 5	.66	93 0	98 3	99	84 5	99
B	30 5	.99	83 0	80 0	80	72 5	60
C	30 0	84	72 0	73 0	20	70 0	80
D	29 9	67	70 0	66 0	20	72 5	80
E	29 8	91	64 0	30 0	19	54 3	30
F	28 3	1 50	48 0	25 0	5	41 0	1

temperatures and five of the traits on which the children were rated The degree of warmth is graduated from the top to the bottom, each figure representing one child's mean for 18 days The child having the highest dorsal hand temperature is rated highest in sociability, the child having the lowest temperature is the least sociable In addition, Case F shows the widest temperature variations from day to day, *A*, the least *B*, whose mean temperature is the same as *A*'s, though highly rated in sociability, is not so much so as *A* Her temperature variations, however, are second highest

in the group, which may be a significantly associated factor. C, D, and E, whose average temperatures approach each other quite closely, are similarly related in sociability. This high correspondence may also be observed with reference to social adjustment and emotional control, with the exception of Subject E in social adjustment, whose mean temperature is only one-tenth of a point lower than D's but sinks in rating almost as low as F. Whether her high relative variability in temperature is significant is a question which cannot be answered with the present data. Aside from her sociability and emotional control ratings, E's ratings are all much lower than those of C and D, whose average temperatures closely approximate hers.

In sociability, social adjustment, emotional control, attractiveness of personality, and effective energy, the extremes hold their positions as well as E. However, in attractiveness of personality D rises from the middle level to rank with B for second place. C and D retain identical scores in effective energy, but B disturbs the relationship quite markedly.

The other three social categories (mental effectiveness, ascendance-submission, and skill in work and play), as well as intelligence scores and oral temperatures, seemed to show little, if any relationship to back of hand temperatures, and will therefore be given no further discussion in this paper.

No correspondence appeared between temple temperatures and social traits. In contrast to a span of 2.2° between the extremes of hand means, the temple span of 0.8° did not adequately differentiate between individuals, taking into account a mean deviation range of 0.4° to 0.9°.

3. *Gradients and Social Traits*

Combination of temple and hand readings into gradient scores, as described previously, uncovered some interesting observations (Table 3). Gradients are essentially as indicative of social traits as are hand surface temperatures ($r = -0.87$), although the relationship is reversed. The data indicate then that high hand surface temperature in relation to temple temperature may be related to good social adjustment. This identity of relationship is to be expected in light of the high correlation found between back of hand readings and temple-hand gradients.

TABLE 3
GRADIENTS AND SOCIAL PERCENTILE SCORES

Subject	Gradient score	Emotional control	Sociability	Ease of social adjustment	Attractive personality	Effective energy
B	101.4	80	83.3	80.0	72.5	60
A	103.4	99	92.0	98.3	84.5	99
E	105.8	19	64.0	30.0	54.5	30
C	106.0	20	70.0	73.0	70.0	80
D	106.1	20	72.0	66.0	72.5	80
F	110.0	5	48.0	25.0	41.0	1

4. *Median Deviations and Effective Energy*

Although effective energy shows a less close relation to surface temperature than do some of the other categories, Table 4, depicting

TABLE 4
MEDIAN DEVIATIONS IN GRADIENTS AND IN HAND TEMPERATURE (DEGREES *C*) WITH RELATION TO RATINGS IN EFFECTIVE ENERGY

Subject	Median deviations in gradients	Median deviations in hand temperature	Percentile scores in effective energy
F	3.6	3.6	1
E	3.4	.91	30
B	1.6	.96	60
D	1.5	.84	80
C	1.3	.84	80
A	1.1	.66	99

the relationship between effective energy and median deviations in gradients and in back of hand temperature, suggests considerable significance in this correspondence. It is suggested by these data that the greater the variability in hand temperature from day to day, the less the child's effective energy.

5. *Corroborative Data: Surface Temperature during Relaxation*

Data from the last experimental group are presented in Table 5, showing, *on a new group of subjects*, that there is a close positive correspondence between hand temperatures and percentile ratings on emotional control. That the children have been fairly represented with respect to their relative emotional status in the group is indicated by the fact that the mean ranking of the three raters, secured twice, with an interval of three weeks, remains essentially

TABLE 5

RELATIONSHIPS SHOWN BETWEEN AVERAGE BACK OF HAND TEMPERATURES (IN DEGREES C) AND TEMPLE-HAND GRADIENTS DURING RELAXED STATES, MERRILL-PALMER PERCENTILE SCORES IN EMOTIONAL CONTROL, AND AVERAGE DEVIATIONS OF BACK OF HAND TEMPERATURE DURING EMOTIONAL STRESS FROM THOSE DURING NON-EMOTIONAL CONDITIONS

Subject	Hand temperatures during relaxation	Gradients	Percentile ratings on emotional control		Temperature deviations from non-emotional to controlled emotional states		Number of instances in emotional control	Temperature deviations from non-emotional to uncontrolled emotional states		Number of instances in non-controlled emotion
			First set	Second set	Plus	Minus		Plus	Minus	
G	32.07	100	86	89	1.1	0.7	3	0.0	0.2	1
H	31.8	104	83	89	3.4	0.0	5	0.3	2.8	4
I	31.4	103	80	88	1.4	0.0	6	0.0	0.5	1
J	31.38	103	52	83	2.4	0.0	2	0.0	1.0	2
K	31.25	105	65	67	0.0	0.0	6	0.0	0.1	6
L	31.2	106	12	30	0.0	0.0	0	0.5	1.48	13
M	31.18	105	6	13	0.0	0.0	2	0.0	0.4	6
N	30.9	107	1	2	0.0	0.0	0	0.0	1.3	17

the same It is a reasonable assumption then that the present standard for rating emotional control, used in both experiments, is reliable Substantial confirmation of the validity of these ratings appears in the last column, where the number of emotional outbursts for each child over the two-week period is reported A definite trend from a small to a large number of outbursts is reported from the top of the column to the bottom

The rankings on emotional control seem then to be validated in two ways (a) Essentially the same status was given to each child relative to the group on two different occasions, and (b) the number of emotional episodes observed in these children over a two weeks' period support the rankings In view of these data, it seems apparent that the conclusions based on the preceding experiment, at least with relation to ratings on emotional control and concomitant hand surface temperature, are justified.

6 *Surface Temperature and Specific Emotions*

Emotional control in this study was accompanied almost without exception by increased hand surface temperature, while non-controlled emotions were manifested with decreased hand surface temperature, as compard to readings under non-emotional situations (see Columns 5 and 7, Table 5) Thus it seems that the skin, as a thermo-adaptive mechanism, functions differently under emotionally controlled states than under emotional outbursts Final interpretation is not offered here, but it is tentatively suggested that the lack of control, which we recognize by characteristic muscular activity of the striated muscles, may cause cooling of the skin through sweating Again, the increased bodily movements accompanying ungoverned emotions may utilize the excess heat, which under the less violent behavior characteristic of emotional control is radiated from the skin, with consequent increase in skin temperature Under both conditions the temperature of the skin would be decreased.

D INTERPRETATIONS

Because of the small number of cases available for this study under conditions necessary for the experiments, few generalizations can be made, but in the respects described, the data are indicative of a relationship between surface temperature and social tendencies

Eddy and Taylor (10), who computed mean skin temperatures

for 50 normal medical students, noted a tendency for the asthetic build to have colder feet and hands Because of the vast literature on this subject of body build in relation to personality (13), this observation leads naturally to the question whether cold extremities are related to schizoid types While the selected group studied have not been diagnosed from this point of view, observation of the data indicates the possibility of a positive relationship between hand temperature and social and emotional adjustment

Assuming, on the basis of numerous studies (17, 22, 23) that a change in heat production is accompanied by a corresponding change in surface temperature of the hands, we might hazard that under controlled external temperature conditions, those with colder hands have less excess heat (energy) within the body than do those with warmer hands Under these conditions more of the blood circulation is, by vasconstriction of skin capillaries, more generally confined within the body with resultant maintenance of normal internal temperature The heat of the back of hand surfaces, according to these assumptions, may therefore be physiologically and psychologically significant in two ways. (*a*) as an indication of the degree to which energy production in the body exceeds the needs for internal functioning, and (*b*) as an index of the relative amount of excess energy available for functions less necessary to organic adaptation, such as social behavior

That insufficient supply of this excess energy may be indicated in certain psychotic states is suggested in numerous studies relating to subnormal circulatory functions and abnormal mental states The circulatory deficiency frequent in schizophrenia as demonstrated by Lewis (16), the low circulatory rating shown by Trentzch (24), the prevalency of cyanosis shown by Cotnell (6), are a few cases in point

Emotional control, sociability, social adjustment, and attractiveness of personality, as indicated here, may be related to energy supply as measured by the surface temperature technique

E. Summary

Having determined, in two preliminary experiments, that, with certain modifications, the "Dermatherm" was adequate and reliable for measuring surface temperature, and that nursery children were

receptive to its use, the relationship between surface temperature and social traits was studied, resulting in the following conclusions:

1. There is a positive relationship between back of hand temperatures and sociability, emotional control, ease of social adjustment, attractiveness of personality, and effective energy

2 There is little relationship between back of hand temperatures and mental effectiveness, skill in work and play, ascendance-submission, or scores on intelligence

3 Temple temperatures do not appear significant as indicators of the traits studied

4 Temple-hand gradients show essentially the same relationship to social traits as do hand temperatures.

5. Median deviations of temple-hand gradients and back of hand temperatures appear inversely related to effective energy.

6. A correlation exists between outdoor and skin temperatures, after one hour adaptation to constant room temperature

7. Instances of emotional control were accompanied by increased hand temperature, while those of non-controlled emotions were accompanied by a decrease.

8. It was suggested that the heat of back of hand surfaces might be significant as an indication of the degree to which energy production in the body exceeds the internal needs and as an index of the excess energy available for functions less necessary for organic adaptation, such as would be expected in social behavior.

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The Journal of Genetic Psychology, 1939, **55**, 415-427

A DEVELOPMENTAL STUDY OF THE BODILY REACTION OF INFANTS TO AN AUDITORY STARTLE STIMULUS*

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A. INTRODUCTION

The present study traces the genetic development of a bodily reaction pattern induced in infants following a sudden intense auditory stimulus (the dropping of a two-pound iron weight three feet to a hard wood surface).

Responses to startle stimuli have been previously reported. Meyer (12) notes that under violent stimulation infants may throw the arms upward, however he does not describe the actual course of movement. Gordon (6), making an extensive study in which he refers to the earlier work of Moro reports the elicitation of the Moro embrace reflex in infants when forcibly striking the table on which the infants were placed. Halverson (7) reports that

> A sudden emotional upheaval will cause the dorsally placed infant to abduct the arm strongly on a great sweeping arc. Then follows the slow gradual and somewhat intermittent adductive movements which carry the upper arm closer to the trunk.

Canestrini (1) has recorded changes in respiration and fontanelle pressure on a kymograph in infants in response to sound. Pratt, Sun, and Nelson (14) used the stabilimeter polygraph technique to measure the amount of activity changes to sounds of a can, snapper, electric bell, and tuning fork. Both of these studies suggest that sound

*Submitted on September 1, 1939, for publication in The Journal of Psychology, but given immediate publication here because of the crowded condition of that journal.

[1]Thanks are due members of the staff of the Middlesex Hospital, Middletown, Connecticut, and also of the St. Joseph's Hospital in Providence, Rhode Island. Particular gratitude is due Dr. Irving Lorge, Dr. Jack Dunlap, and Mr. Arthur Hoffman for their interest and helpful suggestions, and to Dr. Margaret Fries for her courtesy in allowing me the privilege of viewing her film records of infants.

stimuli may have differential effects of their own, and that the general effects of all sounds is disturbing and becomes increasingly so with increased intensity Both studies afford further evidence that the behavior of the newborn infant is influenced in an orderly and measurable way by common sensory stimuli

Stubbs in studies of the behavior of the new-born infant (17) recorded observable responses to sound stimulations, which were classified under the following types: Eyelid closing and opening, eyelid flicker, eyebrow wrinkle, face contraction, and relaxation, head movement increase, general body movement increase and decrease, arm movement increase and decrease, leg movement increase and decrease, and such overt responses as crying, smiling, mouth movements, and eye fixation.

More recently the work of Strauss (16) on the behavioral response to a sudden loud sound has been investigated by Hunt, Clarke, and Hunt (11) By means of the photographic technique they recorded on 16 mm cinematic film the responses of a group of 60 infants, ranging in age from eight days to eighteen months, to the firing of a .22 caliber blank cartridge. The Moro reflex was elicited in all subjects not more than one month old, the age at which the Moro reflex had disappeared in all subjects was found to be between the fourth and fifth months In those cases where the Moro reflex did not appear, the startle pattern described by Strauss as typical of adults was found; although opposed and non-typical movements tended to appear, particularly in the upper extremities. Clark, Hunt, and Hunt (10, 11) also report the presence of plantar responses and incidental responses (crying, escape, sound orientation, etc.) in this same experimental group in response to the auditory stimulus

The tendency for opposed or non-typical movements to appear when the infant responses were investigated for the presence of movements which Strauss describes as typical of the adult startle pattern (16), as well as the question of the relationship of the Moro reflex to the Strauss startle pattern could better be investigated by determining the changes in the bodily reaction pattern of infants at stated intervals during the first 20 weeks of life.

B Procedure

Fourteen infants were used as subjects—eight male, and six female. The babies were photographed within the first 14 hours after birth

and subsequently at one week, four weeks, eight weeks, twelve weeks, sixteen weeks, and at twenty weeks of age. A total of 98 cinematically recorded observations were available for study.

The infants were photographed initially lying flat on their backs in the hospital crib. At the later dates they were photographed lying flat on a regulation canvas cot.

The moving picture camera, placed overhead, was run at 64 frames per second (four times normal speed). The sudden, intense, auditory stimulus was the sound produced by dropping a two-pound iron weight three feet above a hardwood surface.

The pictures were analyzed by three persons working independently. They were scored for the presence of the various behavioral components of the typical Moro response, together with eyelid reflex, and plantar responses and movements of the lower extremities. In cases of disagreement among the scorers, the individual judgments were tabulated.

C. Results

The records of each testing period throughout the 20 weeks show that a bodily reaction pattern in response to a startle stimulus was elicited in all infants. As is indicated in Table 1, the general character of the composite pattern in each infant undergoes a change with age. The interrelated individual movements of trunk and limbs undergo many modifications in kind, amount, and sequence which show an increasingly fine coordination of movements up to the twentieth week.

The response most characteristic of the early weeks (reaching its height in terms of intensity at eight weeks) is the pattern commonly referred to as the Moro embrace reflex, in which the following elements appear:

1. An initial eyelid response.

2a. Primary extension of the upper extremities involving lateral-wise adductive movement of upper arm and shoulder, frequently to or near shoulder height, accompanied by extension in the elbow, supination of the lower arm, extension of hand and fingers (sometimes with tremors).

2b. Subsequent, slow, gradual, clasping movement involving adductive motion in shoulder and upper arm, flexion in the elbow, pronation in the lower arm during which the whole arm describes an arc as the hands are brought to a mid-line

TABLE 1

A DEVELOPMENTAL STUDY OF A BODILY REACTION PATTERN IN INFANTS TO AN AUDITORY STIMULUS

		Subjects A	B	C	D	E	F	G	H	I	J	K	L	M	N	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		First day														One week													
1 Eyelid response (closing)		—	—	—	+	+	—	+	+	+	—	O	+	O	+	+	+	—	—	+	+	+	?	+	—	+	+	+	—
2a Primary abductive-lateral movement of shoulder and upper arm (to or near shoulder height = E)	R	s+	+	+	+	+	+	s+	+	+	+	+	+	+	s+	s+	+	+		+	+	+	+	+	s+	s+	+	+	+
	L	s+	+	+	+	s+	+	+	+	+	+	+	s+	+	s+	s+	+	+		+	+	s+	+	+	s+	s+	+	+	+
or Primary forward flexor movement of shoulder and upper arm (to or near shoulder height = s)	R																		+ +										
Elbow extension	R	+	+	+	+	+	?	+	+	+	+	?	+	+	+	+	+	+	+	+	+	+	+	+	+	+	O	+	+
	L	+	+	+	O	+	+	+	+	+	—	+	+	+	+	+	—	—	+	+	+	+	+	+	+	+	+	+	+
Lower arm supination	R	+	O	O	+	+	O	+	O	?	+	+	+	+	+	+	—	?	O	—	+	+	—	+	+	+	+	+	+
	L	+	—	+	+	+	+	+	O	+	O	+	+	+	+	+	+	+	—	+	+	+	+	+	+	+	+	—	+
Hand extension	R	+	+	O	+	+	—	+	—	+	+	+	+	—	+	+	+	+	—	O	+	+	+	+	+	+	+	+	+
	L	+	+	—	+	+	—	+	—	+	+	—	+	—	+	+	+	+	—	O	+	+	+	+	+	+	O	+	+
Finger extension (tremors = T)	R	+	+	—	+	T+	—	+	—	+	+	+	+	—	+	+	+	+	—	—	+	+	+	+	+	+	+	+	+
	L	+	+	—	+	T+	—	+	O	+	+	?	+	—	+	+	+	+	O	O	+	+	+	+	+	+	O	+	+
2b Secondary adductive movement in shoulders and upper arm	R	+	+			+		+		+	+	+	+	+	+	+	+	+			+	+	+	+	+	+		+	+
	L	+	+			+		+		+	+	+	+	+	+	+	O	+			+	+	—	+	+	—		+	+
Elbow flexion	R	+	+			O		O		?	—	+	+	+	+	+	O	O			+	+	+	+	+	O		+	+
	L	+	+			+		O		+	—	+	+	+	O	+	+	O			+	+	+	—	+	—		+	+
Lower arm pronation	R	O	O			O		O		+	O	—	—	+	+	+	+	+			O	—	+	+	+	+		+	+
	L	+	O			O		+		+	—	—	—	+	+	+	+	+			+	O	O	+	+	—		+	+
Hand extension	R	+	—			+		+		—	+	+	+	+	+	+	—	—			+	+	—	—	+	+		—	—
	L	+	—			+		+		—	+	+	+	—	+	+	+	—			—	+	—	—	+	—		—	—
Finger extension (tremors = T)	R	T	—			T+		+		—	+	T	T+	—	T+	T	—	—			+	T	—	T	T+	+		—	—
	L	T	—			T+		+		—	+	+	+	—	T+	T	+	—			—	I	—	T	T+	—		—	—
Whole arm describing arc bringing hand to mid line position near head (I = incomplete arc although arms show tendency to approach one another)	R	+				+		+		I		I	+		+	+	I	I			+	+		+	+			+	I
	L	+				+		+		I		+	+		+	+		I			+	+		+	+			I	I
3 Head movement, upward		—	—	—	—	+	+	—	+	—	+	—	+	+	+	+	—	—	—	+	+	—	+	—	+	+	—	—	—
4 Trunk extension (arching)		+	?	?	+	O	+	—	+	+	+	—	—	+	?	+	O	O	+	O	+	?	O	+	+	+	—	+	+
5 Hips Primary extension	R	+	—	—	+	—	+	—	+	—	+	—	—	+	—	+	—	—	+	—	+	—	—	+	+	+	—	—	+
	L	+	—	—	—	—	+	—	+	—	+	—	±	—	+	+	—	—	+	—	+	—	+	+	—	+	—	—	+
Secondary flexion	R	+	O	O	+	—	+	—	+	—	+	+	—	+	+	+	+	+	—	—	+	+	O	+	—	—	O	—	+
	L	—	O	—	+	—	+	—	—	—	+	—	O	+	+	—	?	—	—	—	+	+	—	—	—	+	O	O	±
6 Knees Primary extension	R	+	+	+	+	—	+	—	+	—	+	—	—	+	—	+	—	—	+	—	+	—	—	+	+	+	—	—	+
	L	+	—	+	—	—	+	—	+	—	+	—	—	—	+	+	—	—	+	—	+	—	—	+	—	+	—	—	+
Secondary flexion	R	+	O	O	+	O	+	—	+	—	+	—	—	+	+	+	+	+	O	O	+	O	O	+	O	O	O	—	+
	L	+	O	O	+	O	+	O	O	—	+	O	O	—	—	+	O	O	O	O	+	O	O	—	—	+	O	O	—
7 Ankle rotation, inward	R	+	O	O	—	O	+	+	O	+	+	+	—	—	O	+	—	+	+	O	+	O	O	+	+	+	O	O	+
	L	+	O	O	+	O	—	O	O	+	+	+	—	—	O	+	—	+	O	O	+	O	—	+	O	—	O	O	O
8 Plantar responses (Infantile Babinski = B) (+ = presence of)	R	+	+	+	+	O	+	+	+	+	+	+	O	O	+	+	O	+	+	O	B	+	+	+	+	+	+	+	+
	L	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	O	+	+	O	+	+	+	+	+	+	+	+	+

TABLE I (continued)

Four weeks

		A	B	C	D	E	F	G	H	I	J	K	L	M	N
1 Eyelid response (closing)		+	+	−	+	−	+	+	+	−	+	+	+	+	+
2a Primary abductive lateral movement of shoulder and upper arm (to or near shoulder height = s)	R	s+	+	s+		+			s+	+	+	+	s+		
	L	s+	+	+		+			s+	+	+	+	s+		
or Primary forward flexory movement of shoulder and upper arm (to or near shoulder height = s)	R				+		+	s+						+	+
	L				+		+	+						−	+
Elbow extension	R	+	+	+	+	−	+	+	+	+	+	+	+	−	−
	L	+	+	+	+	+	+	+	+	+	+	+	+	−	−
Lower arm supination	R	+	−	+	+	+	+	+	+	+	+	−	+	−	−
	L	+	−	+	+	+	+	−	+	+	−	O	+	−	−
Hand extension	R	+	−	+	−	−	+	+	+	+	−	−	+	−	−
	L	+	−	+	−	+	+	+	+	−	−	−	+	−	−
Finger extension (tremors = T)	R	T+	−	T+	−	−	+	T+	T+	+	−	−	T+	O	−
	L	+	−	T+	−	−	+	T+	T+	+	−	−	T−	−	−
2b Secondary adductive movement in shoulders and upper arm	R	+	+	+	−	+	+	+	+	+	+		+		
	L	+	+	+	−	+	−	+	+	+	±		+		
Elbow flexion	R	+	O	O	+	+	+	O	?	+	+		+		
	L	+	+	+	−	+	+	+	+	+	+		+		
Lower arm pronation	R	−	O	+	+	+	+	+	+	+	+		+		
	L	O	O	+	+	+	+	+	O	+	+		+		
Hand extension	R	+	+	+	+	+	−	+	+	−	O		+		
	L	+	+	+	−	O	−	+	+	+	+		+		
Finger extension (tremors = T)	R	T	+	T	+	+	−	T+	T−	−	O		T+		
	L	T	+	T	+	O	−	T+	T	+	+		T+		
Whole arm describing arc bringing hand to mid-line position near head (I = incomplete arc although arms show tendency to approach one another)	R	+	I	+		I		+	+	I			+		
	L	+	I	+		I		+	+	I			+		
3 Head movement, upward		+	+	+	−	−	+	−	+	+	−	−	−	−	−
4 Trunk extension (arching)		+	?	−	−	O	+	−	+	O	−	−	+	−	−
5 Hips: Primary extension	R	−	−	+	−	−	+	−	−	−	−	−	+	−	−
	L	−	±	+	+	−	+	−	+	−	−	−	+	−	−
Secondary flexion	R	O	+	O	+	O	+	O	+	+	+	+	+	O	O
	L	O	+	+	−	O	+	+	+	+	+	+	+	O	O
6 Knees: Primary extension	R	−	−	+	−	−	+	−	+	−	+	−	+	−	−
	L	−	+	+	−	−	+	−	+	−	+	−	+	−	−
Secondary flexion	R	O	+	+	+	O	+	O	+	O	O	O	+	O	O
	L	O	+	+	+	O	+	O	+	O	O	O	+	O	O
7 Ankle rotation, inward	R	+	+	−	−	+	−	+	+	+	O	O	−	O	O
	L	+	+	−	−	−	−	+	+	+	−	+	+	O	−
8 Plantar responses (Infantile Babinski = B) (+ = presence of)	R	+	+	+	−	+	O	+	+	+	+	+	+	O	+
	L	+	−	+	+	+	+	B	+	+	+	+	B	+	+

Eight weeks

		A	B	C	D	E	F	G	H	I	J	K	L	M	N
1 Eyelid response (closing)		+	+	+	+	+	+	+	±	+	+	+	+	+	+
2a Primary abductive lateral movement of shoulder and upper arm (to or near shoulder height = s)	R	s+	s+	+		s+	+		s+	+	+		s+		
	L	s+	s+	+		s+	+		s+	+	s+		+		
or Primary forward flexory movement of shoulder and upper arm (to or near shoulder height = s)	R				s+			+				+		s+	+
	L				s+			+				+		s+	+
Elbow extension	R	+	+	+	+	+	+	−	+	+	+	−	+	+	−
	L	+	+	+	+	+	+	+	+	+	+	−	+	+	±
Lower arm supination	R	+	+	+	+	+	−	−	+	+	+	−	+	+	−
	L	+	+	+	+	+	O	+	+	+	−	−	O	+	−
Hand extension	R	+	+	+	+	+	−	−	+	−	+	−	+	+	−
	L	+	+	+	+	+	−	−	+	−	+	−	+	+	−
Finger extension (tremors = T)	R	T+	T+	+	T+	+	−	−	T+	−	+	−	+	+	−
	L	T−	T+	+	+	+	−	−	+	−	T+	−	+	+	+
2b Secondary adductive movement in shoulders and upper arm	R	+	+	+	+	+			+	+	+	−	+	−	
	L	+	+	O	−	+			+	+	+	−	O	−	
Elbow flexion	R	+	+	+	+	O			+	+	O	+	+	+	
	L	+	+	+	+	O			+	+	+	+	+	+	
Lower arm pronation	R	+	+	−	+	+			+	+	+	+	O	+	
	L	+	+	O	+	+			+	+	+	O	O	−	
Hand extension	R	+	+	+	+	+			+	O	+	+	+	+	
	L	+	+	+	−	+			+	O	+	+	+	+	
Finger extension (tremors = T)	R	T+	T	T	T	T+			+	−	T+	+	T	T	
	L	T+	T	+	T	T+			+	−	T	+	T	T	
Whole arm describing arc bringing hand to mid-line position near head (I = incomplete arc although arms show tendency to approach one another)	R	+	+	I	+	+			+		+		I	+	
	L	+	+		+	+			+		+		+	+	
3 Head movement, upward		+	+	+	−	+	−	+	+	−	−	−	−	−	−
4 Trunk extension (arching)		−	+	+	−	+	O	+	+	−	−	O	+	−	O
5 Hips: Primary extension	R	+	+	+	−	+	−	+	+	−	−	−	−	−	+
	L	+	−	−	−	+	−	−	+	−	−	−	−	−	+
Secondary flexion	R	O	−	+	O	+	+	+	+	O	O	O	+	+	+
	L	+	+	−	+	+	−	−	O	+	O	−	−	−	−
6 Knees: Primary extension	R	+	+	+	+	+	−	+	+	−	−	−	−	−	+
	L	+	+	+	+	−	−	+	+	−	−	−	+	−	+
Secondary flexion	R	+	−	+	O	+	+	+	−	O	O	O	+	O	+
	L	+	−	−	O	+	O	+	+	O	O	+	+	O	+
7 Ankle rotation, inward	R	+	−	−	O	+	+	+	+	−	O	O	+	O	O
	L	+	−	−	+	+	−	+	+	−	O	O	+	O	+
8 Plantar responses (Infantile Babinski = B) (+ = presence of)	R	+	+	−	−	+	−	+	+	+	−	+	+	+	−
	L	+	+	+	+	+	+	+	+	+	+	+	B	+	−

TABLE 1 (continued)

		Subjects																											
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	A	B	C	D	E	F	G	H	I	J	K	L	M	N
		Twelve weeks														*Sixteen weeks*													
1 Eyelid response (closing)		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2a Primary abductive-lateral movement of shoulder and upper arm (to or near shoulder height = s)	R	+	s+	s+		s+			+	+		s+	+			+	+	s+		s+			+			+	+		
	L	+	+	s+		+			—	+		s+	+			+	+	+		s+			+			+	+		
or Primary forward flexory movement of shoulder and upper arm (to or near shoulder height = s)	R				+		+	—			+			+	+				+		+	+		+	+			+	+
	L				+		+	—			+			+	+				+		+	+		+	+			+	+
Elbow extension	R	—	+	+	—	+	—	+	+	+	+	+	+	—	—	+	+	+	—	+	—	—	—	+	+	—	+	—	—
	L	+	+	+	—	—	—	+	+	+	+	+	—	—	—	+	+	+	—	+	—	—	—	+	—	—	+	—	—
Lower arm supination	R	—	—	+	—	+	—	+	—	—	+	+	+	—	—	—	+	+	—	+	—	—	—	—	—	—	+	—	+
	L	+	—	+	—	—	—	—	—	—	+	+	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—
Hand extension	R	—	—	+	—	+	—	—	+	—	+	—	—	—	—	—	—	+	—	+	—	—	—	—	—	—	+	O	—
	L	—	—	+	—	+	—	—	+	—	+	—	—	—	—	—	—	+	—	+	—	—	—	+	—	—	+	—	—
Finger extension (tremors = T)	R	—	—	T+	—	+	—	—	+	—	+	—	—	—	—	—	—	+	—	T+	—	—	—	—	—	—	+	—	—
	L	—	—	T+	—	+	—	—	+	—	+	—	—	—	—	—	—	+	—	T+	—	—	—	—	—	—	—	—	—
2b Secondary adductive movement in shoulders and upper arm	R	+	+	+		+			+	+		+	+				+	+		+							+		
	L	+	+	+		+			+	+		+	+				+	+		+							+		
Elbow flexion	R	+	+	+		+			+	+		+	+				+	+		+							+		
	L	+	+	+		—			+	+		+	—				+	+		+							+		
Lower arm pronation	R	—	+	+		[illegible]			O	O		+	+				+	+		+							+		
	L	—	+	+		+			—	+		+	+				O	+		+							+		
Hand extension	R	—	+	+		—			—	+		+	—				+	+		+							+		
	L	—	—	O		—			—	—		+	—				+	O		—							—		
Finger extension (tremors = T)	R	—	+	+		—			—	+		+	—				+	+		+							+		
	L	—	—	+		—			—	—		+	—				+	O		—							—		
Whole arm describing arc bringing hand to mid-line position near head (I = incomplete arc although arms show tendency to approach one another)	R	I	I	+		I						+					I	+		+							I		
	L	I	I	+								+					+	+		I									
3 Head movement, upward		—	+	+	—	+	—	—	—	—	—	+	+	—	—	—	+	+	—	—	—	—	—	—	—	—	—	—	—
4 Trunk extension (arching)		—	+	+	—	+	—	—	—	—	—	+	+	—	—	—	+	+	—	—	—	—	—	—	—	—	—	—	—
5 Hips Primary extension	R	—	+	+	—	+	—	—	—	+	—	+	+	—	—	+	+	+	—	+	+	—	—	—	—	—	—	—	—
	L	—	+	+	—	+	+	±	+	+	—	—	+	—	—	+	+	+	+	+	—	—	—	—	—	—	—	+	—
Secondary flexion	R	O	+	+	O	+	+	+	+	+	O	O	+	O	O	+	+	+	O	+	+	—	+	+	—	+	+	—	+
	L	+	+	O	O	+	+	+	+	+	O	O	+	O	O	+	+	+	O	+	O	O	O	+	+	—	+	+	+
6 Knees Primary extension	R	—	+	+	—	+	—	—	—	+	—	—	+	—	—	+	+	+	—	+	+	—	—	—	—	—	—	—	—
	L	—	+	+	—	+	+	±	+	+	—	—	+	—	—	+	+	+	±	+	—	—	—	—	—	—	—	+	—
Secondary flexion	R	O	+	+	O	+	+	+	+	+	O	O	+	O	O	+	+	+	+	+	+	O	O	O	O	O	O	O	+
	L	O	+	+	O	+	+	+	O	O	O	O	+	O	O	+	+	+	O	+	O	O	O	O	+	—	+	+	+
7 Ankle rotation, inward	R	+	+	—	O	+	+	+	—	—	O	O	+	+	+	+	+	+	O	+	O	+	+	+	+	—	—	+	+
	L	+	+	—	O	+	—	+	O	O	+	—	+	+	+	+	—	+	+	+	+	+	+	+	+	—	—	+	+
8 Plantar responses (Infantile Babinski = B) (+ = presence of)	R	+	+	+	O	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	O	O	+	O
	L	+	+	+	O	B	O	O	+	O	+	O	+	+	+	+	+	+	+	+	+	+	O	+	+	+	+	+	+

TABLE 1 (*continued*)

		Subjects A	B	C	D	E	F	G	H	I	J	K	L	M	N
		Twenty weeks													
1 Eyelid response (closing)		+	+	+	+	+	+	+	+	+	+	+	+	+	+
2a Primary abductive lateral movement of shoulder and upper arm (to or near shoulder height = s)	R			+		+			+			+	+		
	L			+		+			+			+	+		
or Primary forward flexory movement of shoulder and upper arm (to or near shoulder height = s)	R	+	+		+		+	+		+	+			+	+
	L	+	+		+		+	+		+	–			+	+
Elbow extension	R	–	–	+	+	+	+	–	+	–	–	–	+	–	–
	L	–	–	+	–	+	+	–	+	–	+	–	+	–	–
Lower arm supination	R	–	–	+	+	+	–	–	–	–	–	–	–	–	–
	L	–	–	+	–	+	–	–	–	–	–	O	O	–	–
Hand extension	R	–	–	+	–	+	–	–	–	–	–	–	–	–	–
	L	–	–	+	–	+	–	–	–	–	–	–	–	–	–
Finger extension (tremors = T)	R	–	–	+	–	+	–	–	–	–	–	–	–	–	–
	L	–	–	+	–	+	–	–	–	–	–	–	–	–	–
2b Secondary adductive movement in shoulders and upper arm	R			+		+									
	L			+		+									
Elbow flexion	R			+		+									
	L			+		+									
Lower arm pronation	R			+		+									
	L			+		+									
Hand extension	R			–		–									
	L			–		–									
Finger extension (tremors = T)	R			–		–									
	L			–		–									
Whole arm describing arc bringing hand to mid line position near head (I = incomplete arc although arms show tendency to approach one another)	R														
	L														
3 Head movement, upward		+	–	–	–	–	–	–	–	+	–	–	–	–	–
4 Trunk extension (arching)		?	–	–	–	–	–	–	–	+	–	–	–	–	–
5 Hips Primary extension	R	–	–	+	–	+	–	–	–	–	–	–	+	+	+
	L	–	–	+	–	+	–	+	+	+	–	–	+	+	±
Secondary flexion	R	+	O	+	O	+	+	–	–	+	+	O	+	–	–
	L	+	O	+	O	+	+	–	–	+	+	O	+	–	+
6 Knees Primary extension	R	–	–	+	–	+	–	–	–	–	–	–	+	+	+
	L	–	–	+	–	+	–	–	+	+	–	–	+	+	–
Secondary flexion	R	O	O	+	O	+	+	+	+	+	+	O	+	+	–
	L	O	O	+	O	+	+	–	–	+	+	O	+	–	–
7 Ankle rotation, inward	R	+	+	+	–	+	+	–	–	–	–	O	+	+	O
	L	+	+	–	+	+	+	O	O	O	+	O	+	+	O
8 Plantar responses (Infantile Babinski = B) (+ = presence of)	R	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	L	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Key
+ = positive response
– = negative response
O = no movement
? = concealed
± = disagreement of scorers
s = arms raised to shoulder height
T = tremors in fingers
I = arms show a tendency to approach one another but do not describe a complete arc
B = infantile Babinski response

position near the head Moro and Freudenberg refer to this element of the response as a protective clasping movement (13, 5).

3 Extensory movements in head and trunk (arching)

4 Extensory, flexory, or flexory followed by extensory, or extensory followed by flexory responses in the knees and hips

5 Turning in of ankles

6 Plantar responses as overflow or secondary responses, in which flexory, extensory, or mixed movements may occur The infantile Babinski appeared in one of seven recordings in five cases

The primary extensory movements of the trunk and limbs are gradually replaced by flexory movements characterized by greater finesse and less intensity The subsequent clasping movement of the arm, which appears with greatest frequency in the eighth week, dies out as primary flexory replace early extensory movements in the upper extremities By the twentieth week the subsequent clasping movement of the arms had disappeared and in but two cases were the movements described by the arms at all suggestive of this early pattern

Throughout the first two months the shoulder movements seem to dominate the directional movement of the arms and hands. The shoulder, as it moves laterally in abductive fashion, often carries the arm about with little or no elbow extension or flexion. When the arm abducts to or near shoulder height, supination occurs, when the arm returns on its adductive phase, pronation takes place The degree of lateral movement of the arms decreases with age A study of the motion picture record of the arm movements reveals that up to the twelfth week lateral-wise abductive and adductive movements of the shoulder are made with greater facility than forward flexory movements which take the arm out of the body plane Forward flexory movement in the shoulder and upper arm, while appearing as early as the first week, becomes an increasingly characteristic element of the response during the sixteenth and twentieth weeks At the same time flexory movements in the elbow, hands, and fingers, and pronation in the lower arm appear with greater frequency as primary movements in the startle response.

The total response secured in infants 16 and 20 weeks of age more nearly resembles the startle pattern reported in children by Hunt and Clarke (10).

The relative intensity of the response observed varied from individual to individual, also within the same individual from one observation period to the next

There appears to be a relationship between the persistence of the Moro reflex and the calculated gestation period In the three infants whose calculated gestation was less than 31 weeks, the Moro persisted into the sixteenth week In two of these cases, although a weak response was elicited during the first two observations, certain elements of the Moro response persisted into the twentieth week. On the other hand, in five of the seven records of an infant in whom post maturity was indicated, a mild, well organized response, generally flexory in character was elicited.

In the remaining 10 infants for whom normal gestation was reported, individual differences were observed in the strength of the response during any one testing period, and in the time at which primary flexory movements tended to replace extensory movements Two infants who were circumcised on the eighth and tenth day, showed a greater excitability and more intense response to the startle stimulus during the fourth and eighth week testing periods than in previous or subsequent examinations

D Discussion

Such information as is available in regard to the neuro-physiology of early infancy appears to bear a relationship to the changes observed in the response pattern (particularly in the upper extremities) observed in the group of 14 infants followed in this study from birth to the twentieth week

In Halverson's studies (7, 8) of the development of prehension in infancy, and of early grasping response, we find an interesting parallel in the type of arm movements the infant executes in the early months. Halverson (7) reports early movements of the arm to be lateral or principally lateral in character, as well as jerky and discontinuous. The shoulder activity seems to dominate the first voluntary reaching movements of the upper extremities Restriction in the use of the elbow and forearm are reported as characteristic of reaching movements up to the twenty-fourth week Halverson seeks an explanation for these findings of retarded functioning of the forearm and hand, in the incompleted development of both the peripheral nerves and the higher nervous centers for several

weeks after birth His studies show that not until the third or fourth month has development within the nervous system reached a stage when some cortical control over prehensile activities may be expected

Such neurological evidence as is available points to an incompleted development of peripheral nerves and muscles for several weeks after birth Neither the effector nerves to the muscles, nor the musculature itself is functionally well developed at birth, accounting in part for the gross nature of the movements observed in the younger subjects in response to an auditory startle stimulus.

Heptner (9), after comparing the arm of a new-born boy with the right arm of a three-year-old boy and the arms of two men, concludes that the forearm of a new-born boy is, with respect to musculature and nerves, less well developed than the upper arm. The ratio of the growth of the peripheral nerves of the arm of the three-year-old boy to that of the new-born boy is 4 to 1.

Westphal and MacCallum (19) show that microscopically the individual muscular fibers of new-born infants have about one-third the diameter of similar fibers in year-old infants. In addition the fibers at birth are round, while in adulthood, they are polygonal. Some of them are polygonal at three weeks, while others remain round even after one year

Further investigations of Westphal show that muscular response to electric stimulation in children varying in age from one hour to eight years is less intense for the first few weeks of life, and that muscle contraction occurs at a slower rate in younger than in older infants (18).

The cerebellum at birth is 6 per cent of the total brain weight and within a month's time it grows to form 10 per cent of this mass, showing more rapid development in postnatal growth than does the cerebrum The cerebellum attains practically its full size before the fifth year Since the cerebellum concerns itself with body equilibrium, muscular tone, muscular coordination and adjustments—in short, the synergy of muscle response—this rapid increase within the first month after birth is significant in interpreting the increasing finesse of movements noted in the present study of infant response to an auditory stimulus. The presence of tremor of the fingers, discontinue movements of the shoulder and arm, plantar responses, etc., elicited in greatest frequency during the early weeks,

point to a lack of synergy governing the character of the pattern elicited (15).

The order of muscular development is in a distal direction, the differentiation of structures of the upper arm preceding that of the forearm, in turn preceding that of the hand (15). This is noted in the persistence of extensory movements in the elbow, and in the persistence of restriction of movement in the lower arm, wrist, etc., as indicated in the data presented in Table 1, and also in the tendency of the shoulder to determine the directional movement of the whole arm in the early weeks.

Feldman (4) holds that all movements of the body at birth are reflexes and that incomplete development of the inhibitory centers accounts for their exaggeration. Certainly the movements recorded in the early months in response to a startle stimulus are more intense, more jerky, discontinuous, often delayed, and greater in incidence than those appearing in the sixteenth and twentieth weeks.

While the complete answer to the questions implied in this discussion depends upon a neuro-physiology which is at present lacking, it would seem that the problem of the relationship of the early primary generally extensory response to an auditory startle stimulus and the later increasingly flexory one, can be explained in terms of the imperfectly developed condition of the peripheral nerves and muscles and the central nervous system during the early months following birth. The greater incidence and quantity of leg movements, arm movements, plantar and finger movements in infants as compared to children and adults, points to this lack of control by higher centers.

E. Summary

An investigation of the bodily response of 14 infants during the first 20 weeks after birth to an auditory startle stimulus—the dropping of a two-pound iron weight a distance of three feet to a hard wood surface, shows a gradual breakdown of certain elements in the Moro response first elicited.

The pattern consists of an initial eyelid response, a primary extension of the upper extremities (involving lateral-wise abductive movement of the upper arm at shoulder, frequently to or near shoulder height) accompanied by extension of the elbow, supination of the lower arm, extension of the hands and fingers, and followed by a

slower clasping movement (involving adductive movement in the shoulder and upper arm, flexion in the elbow, pronation in the lower arm), during which the whole arm describes an arc as the hands are brought to a mid-line position near the chest and head During the course of movement the fingers frequently exhibit tremors Coincident with the primary movements in the upper extremities, extensory movements in the head and trunk occur Extensory, flexory, including secondary flexory and extensory movement in the knees and hips, turning in of the ankles, and plantar responses were observed as secondary responses in which flexory, extensory, or mixed responses appear

This pattern, which frequently occurs in incomplete form, persists over varying intervals of time, depending on the individual infant The relative intensity of the response varies from individual to individual, and within the same individual from one observation period to the next.

The bodily reaction pattern gradually changes to one which is primarily flexory in character, in which the movements are less intense, and certain secondary movements (such as the subsequent clasping response of the arms) die out. Flexory, forward movements of the shoulder and upper arms also gradually replace the early lateral-wise abductive, adductive movements as characteristic elements. By the twentieth week, in all subjects the primary response was generally flexory in character

An explanation of the change in the general character of the pattern can in part, be found in such neurological evidence as is at present available, which points to an imperfectly developed condition of peripheral nerves and muscles and the central nervous system during the early months following birth

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SHORT ARTICLES AND NOTES

The Journal of Genetic Psychology, 1939, 55, 429-434

RE-ADMINISTRATION OF THE WITMER FORM-BOARD TO FEEBLE-MINDED SUBJECTS*

The Training School at Vineland

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The Witmer formboard has long been considered a useful instrument for the testing of children, but no study has yet appeared evaluating effects of re-administration. Norms are available only for its first administration.[1] In other words, if we compare the present Witmer score of a subject with the score obtained by the same subject one year previous, norms are not available for the interpretation of differences. In order to meet this difficulty, if only partially, we have gathered the scores of subjects, each of whom had been tested on the Witmer on four different occasions. Since our subjects were all feeble-minded, life age could not be used as a comparative index. The Stanford-Binet mental age was therefore used as a substitute index.

The data were obtained from the files of the psychological clinic of the Vineland Training School. The selection of records was based on the following criteria:

> 1. The subject has been given the Witmer formboard on four different occasions during residence. (The time interval between two different applications was found to be between 2 years to 20 years.)
>
> 2. So far as could be determined, the subject had not been given the Witmer or any other formboard test prior to admis-

*Received in the Editorial Office on September 16, 1938.

[1]The procedures and norms used in this study are those of Young (4). Young used the shortest of three trials as the basis for his norms. For a recent statistical evaluation of the Witmer formboard, see the thesis by Simmons (2). Simmons maintains that the best method of scoring the Witmer is by averaging the first three trials. Norms based on this scoring procedure have not yet been established.

sion to The Training School Moreover, a subject's record was discarded if it was found that during residence the subject had been given formboard tests other than the Witmer during the period of time for which the Witmer scores were under consideration

3 The subject had been given a Stanford-Binet intelligence examination on the same four occasions when the Witmer had been given

4 The Stanford Binet mental age of the subject was not lower than four years, nor greater than nine years[2]

Fifty-seven subjects were thus selected for study The characteristics of these subjects at the time of the first administration were as follows Life age varied from 7 0 to 14 3 years, Binet mental age ranged from 4.0 to 8.5 years (*IQ*'s 38-85), Witmer median ages ranged from 3 0[3] to 15 5 years Additional facts are summarized in Table 1

TABLE 1

MEANS, SIGMAS, AND SIGMAS OF THE MEANS FOR LIFE AGE, BINET MENTAL AGE AND *IQ*, AND WITMER MEDIAN AGE FOR THE 1ST, 2ND, 3RD, AND 4TH ADMINISTRATIONS OF THE WITMER AND BINET

Administration	Life age Mean	Life age σ	Life age σ_m	Binet Mental age Mean	Binet Mental age σ	Binet Mental age σ_m	Binet *IQ* Mean	Binet *IQ* σ	Binet *IQ* σ_m	Witmer Mean	Witmer σ	Witmer σ_m
1st	10 0	1 9	25	6 1	1 3	17	62	11	1 5	7 2	2 2	29
2nd	10 6	1 9	25	6 4	1 3	17	61	10	1 4	8.0	2 2	29
3rd	11 5	2 0	26	6 8	1 3	18	60	12	1 6	9 4	3 4	.45
4th	12 7	2 1	28	7 2	1 3	18	59	9	1 2	9 7	3 2	42

From an inspection of this table we see that at the first administration the mean Witmer median age exceeded the mean Binet mental age by 1 1 years; at the second administration, the mean Witmer median age exceeded the mean Binet mental age 1 6 years, at the third administration, the Witmer increment over the Binet was 2 6 years, at the fourth administration, the Witmer increment

[2]The Witmer is most useful between the ages of four and nine years In this study, because the subjects were feeble-minded, the mental age criterion is substituted for the life age criterion

[3]There was one subject who did not come up to the four-year norms on the Witmer although he had a Binet *MA* of 4 7 years. In order not to distort the data by omitting his score, his Witmer performance was judged on the basis of speed and comprehension and placed at three years

over the Binet was 2.5 years.[4] The mean Witmer median age was always higher than the mean Binet mental age, and further, the difference tended to become progressively greater up to and including the third administration.

If we subtract the first mean Binet mental age, 6.1 years, from the fourth mean Binet mental age, 7.2 years, and then divide the difference, 1.1 years, by the first mean Binet mental age, the Binet ratio is .17. Following the same procedure for the Witmer, we subtract the first mean Witmer median age, 7.2 years, from the fourth mean Witmer median age, 9.7 years, and then divide the difference, 2.5 years by the first mean Witmer median age, getting a Witmer ratio of .35. By this method of comparison, the Witmer scores increased twice as much as the Binet scores during the same time interval.

Another method of calculation yields essentially the same relationships. If the difference between the first Binet mental age and the fourth Binet mental age, 1.1 years, is divided by the time interval elapsing between the two, 2.7 years, the ratio is .37. If the difference between the first Witmer median age and the fourth Witmer median age, 2.5 years, is divided by the time interval between the two, 2.7 years, the ratio is .93. In this instance, the Witmer ratio is 2.5 times as large as the Binet ratio.

The relationship between the mean Witmer median ages and the mean Binet mental ages is illustrated graphically in Figure 1. It is apparent from an inspection of the two curves that the Witmer increments are progressively greater than the Binet increments at each application. The Witmer curve is at all points above the Binet curve.[5]

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[4] It is not statistically justifiable to compare the scores from one test with scores on another test when the tests are derived from different standardization samples. In this paper it was thought justifiable to disregard the issue of standardization in order to answer the practical clinical question: Is the Witmer median age of feeble-minded subjects higher than their Binet mental age?

[5] As a matter of interest it should be pointed out that the partial product-moment coefficient of correlation between the first Binet and the first Witmer, holding life age constant, is .63, between the second Binet and second Witmer, .44, between the third Binet and third Witmer, .58, between the fourth Binet and fourth Witmer, .62. There is a significant difference between the mean Binet score and the mean Witmer score at each administration: the $\frac{D}{\sigma_D}$ for the first administration is 4.9, for the second administration, 6.3, for the third, 6.8, and for the fourth, 7.4.

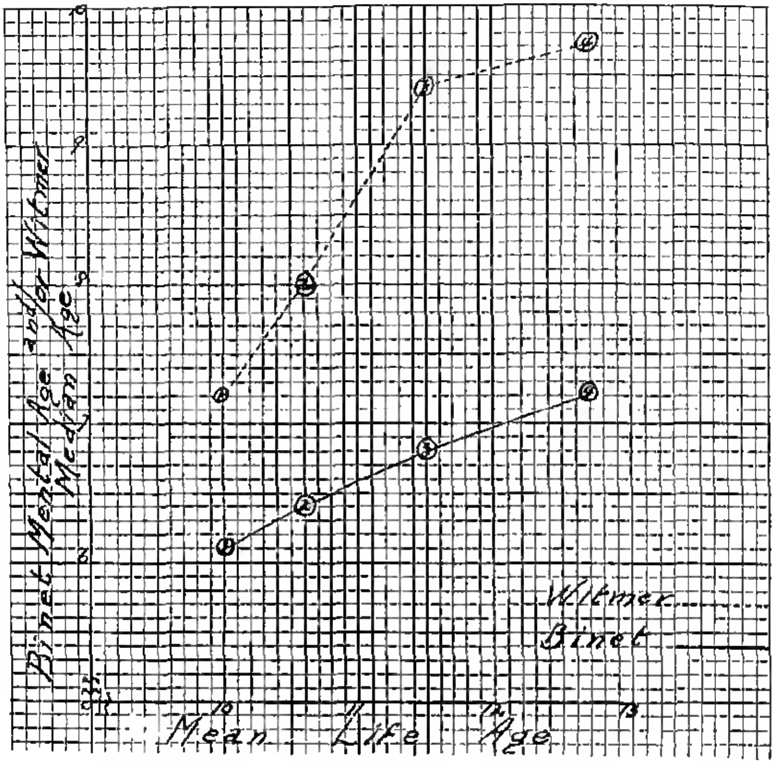

FIGURE 1

Graphs illustrating relationship between mean Binet mental ages and mean Witmer median ages at the 1st, 2nd, 3rd, and 4th administrations of the tests. The broken line represents the Witmer, the unbroken line represents the Binet, and the encircled numbers indicate the administration. The curves are based on data from 57 subjects, each of whom was given the Binet and Witmer tests on the same day on four successive occasions. The mean time interval between the 1st and 2nd administrations was .73 years; between the 2nd and 3rd administrations .92 years; between the 3rd and 4th administrations 1.12 years.

Graphs of the same type as that shown in Figure 1 were plotted for each of the 57 subjects. It was found that five of the subjects had Witmer curves consistently below the Binet curves, i.e., the Witmer score on each of the four different occasions was lower than the Binet score. With 15 subjects the Witmer scores were

sometimes higher and sometimes lower than the Binet scores, in 8 of these 15 subjects the Witmer score was lower on only one of the four instances. With 37 subjects (65 per cent) the Witmer scores were always higher than the Binet scores, the curves overlapping at no point This analysis of the data reveals that the differences between the Witmer and Binet scores, as shown in Figure 1, cannot be attributed to the large Witmer scores of just a few subjects The differences are consistent for the majority of subjects

A question in need of clarification is: Are the successively larger Witmer scores the result of practice or are they the result of growth of intelligence? In order to shed some light on this questoin we examined the data of the first administration. Subjects were classified in accordance to their Binet mental ages, those with mental ages between 4 and 5 were grouped together, likewise for those falling between 5 and 6, 6 and 7, 7 and 8, and 8 and 9 It was found that subjects with mental ages between 4 and 5 averaged .7 years higher on the Witmer; those with mental ages between 5 and 6 also averaged .7 years higher on the Witmer; those with mental ages between 6 and 7 averaged 1.1 years higher on the Witmer, those with mental ages between 7 and 8 years averaged 1.4 years higher on the Witmer; and those with mental ages between 8 and 9 averaged 1.8 years higher on the Witmer These differences are not statistically significant, presumably because of the small number of cases in each category But, nevertheless, there is a tendency indicating that the higher the Binet score, the greater the difference between the Witmer and Binet scores. To some extent, then, the successively higher scores on the Witmer may be attributed to increased intelligence, but this factor alone does not account for all the difference and we may therefore assume that the residual difference is due to practice

There is, of course, the likelihood that the intelligence of the feeble-minded may be more adequately measured by a performance type test than by a predominantly verbal scale, such as the Binet. This possibility may be entertained, but in the absence of experimental evidence there would be no justification that the Witmer type of formboard would be adequate for such a comparison

Conclusions

1. Feeble-minded subjects tended to score higher on the Witmer

than on the Binet, not only at the time of the first administration but also on three other successive occasions. (The time interval between the testing occasions varying from 2 to 20 years.)

2. The successive Witmer scores are progressively higher than the Binet scores up to and including the third re-administration.

3. There is a slight tendency for subjects with higher Binet mental ages to show more capitalization on the Witmer.

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The Journal of Genetic Psychology, 1939, 55, 435-437

A NOTE ON PREHENSION IN A CAPTIVE ORANG-UTANG*

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The form of the orang hand has recently been described by Midlo (1). The digital formula, $3 > 4 > 2 > 5 > 1$, represents what is probably basic simplicity in the architecture of the vertebrate hand. In the orang, owing to a striking elongation of the carpal and phalangeal bones, the hand is longer and narrower than that of the chimpanzee or man, being comparable rather to that of the *Hylobatidae*. The thumb is abbreviated, projecting below the level of the head of the metacarpal bone of the index finger. The distal volar surfaces of the fingers other than the thumb are calloused and insensitive, and, in the specimen studied, are clearly delineated from the distal phalanx by a small crease in the skin which appears to mark the tip of that bone. Typically the nails, very closely attached to the sole-pad, are arched and angle sharply toward the palmar surface of the hand. Compared with the more spatulate features of the chimpanzee and human hands the orang hand appears trowel-like in contour. As a final structural consideration, it may be noted that the fissures on the palmar integument run longitudinally, merging with a second family of lines marking the point of adduction of the thumb. The latter contrast with the more oblique fissures found in those species in which a genuine thumb-forefinger opposition is possible, reflecting an inflexibility of movement.

The method employed in studying the animal's prehensive behavior was the following. The subject, a female orang-utang (*Pongo pygmaeus*), in its estimated sixth year of life, was regularly conducted just prior to feeding time to a quiet room where it was made to assume a sitting position on a chair before a large table-top level

*Recommended for publication by J. F. Fulton, and received in the Editorial Office on October 19, 1938.

[1]The author is grateful to Prof. J. F. Fulton for the use of the animal and the experimental facilities of the Laboratory of Physiology, Yale University School of Medicine, where the observation was made.

with the elbows Here it was confronted with a small rack containing two shelves, one level with the table-top, the other raised 12 inches above Three stimulus objects, placed before it at various distances, levels, and right-left positions, were employed (*a*) a two-inch wooden cube, (*b*) a ball 2 5 inches in diameter, and (*c*) a pellet (shelled peanut)

During 50 observations, using the controlled variations of conditions mentioned above, the sphere was invariably prehended in the same manner. The hand was directed straight toward the ball with a minimum of useless movement, in grasping, the thumb was wrapped around the ball horizontally with the hand pronated. In holding the ball, the thumb was released entirely. Results obtained during 50 observations with the cube paralleled those just described with the characteristic difference, allowed by structural dissimilarities between the two objects, that the thumb was more adducted and was flexed at the phalangeal joint

Four modes of prehending the small pellets were distinguishable (*a*) The simplest consisted in seizing the object directly with the mouth (*b*) Occasionally the pellet was "corralled" to a point within "mouthing"-distance, by using the ulnar edge of the hand, the fingers being slightly curled to prevent the object from sliding off the finger-tips (*c*) More often, the arm was lowered from the elbow, and the dorsal surface of the hand placed over the pellet which was then pinched in the interdigital space between the 2nd and 3rd, or the 3rd and 4th fingers. (*d*) Most commonly the pellet was clamped with the flexed hand between the thumb and the mesial surface of the forefinger, near the second phalangeal joint The data suggest that the conditions under which each form of prehension is dominant in this animal are as follows· "Thumb-forefinger opposition" is preponderant when the pellet is relatively distant from the subject (20 inches from the navel), in the superior plane. By lowering the stimulus to the level of the table-top and placing it in a proximal position (10 inches), the 2-3, 3-4 pincer response could be evoked with constancy. "Corralling" was frequent when the pellets were placed in the inferior and proximal position Mouthing was likewise frequent when the stimulus was in the low, near position Throughout 200 observations no tendency toward manual dominance was observed; the use of either the right or the left hand was conditioned by the proximity of the stimulus to the particular member.

In general, the orang hand, with its smaller thumb, differs from that of the chimpanzee in being more adapted to locomotion than to prehension, the thumb playing little rôle in the arboreal functions of hanging and brachiation characteristic of the orang and the gibbon. Schematically, the hand of the orang may be thought of as specialized to the grasping of a cylinder (e g , branch), in contrast to the more flexible hand of the chimpanzee or of man modified to the prehension of manipulatable objects. Adaptation of the hand to the rôle of locomotion with the consequent lack of manual dexterity correlates with the relatively smaller cerebral development and differentiation in this primate, and offers a possible explanation for the existence of its several functionally equivalent, and hence unspecialized, modes of prehension

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The Journal of Genetic Psychology, 1939, 55, 439-442

PRECURSOR SIGNS OF PLANTIGRADE PROGRESSION IN THE HUMAN INFANT*

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A. INTRODUCTION

An earlier study of prone progression in the human infant (1, 2) has suggested that there are at least 14 stages in the normal prone sequence, the last of which is plantigrade progression or creeping on hands and feet. Of 20 infants studied, 14 exhibited plantigrade progression before walking. This somewhat high percentage suggests that this phenomenon is a natural and may even once have been a universal end stage of the prone sequence.

Since this type of behavior is exhibited by some infants but not by others, we may raise the question of whether or not plantigrade progression has any precursor signs which would, at an early age, foretell such behavior. A review of the 14 prone stages suggests that such precursor signs may be observed in Stages 1 and 2 of the normal prone sequence.

These two similar but distinguishable types of behavior are both characteristic of the 28 weeks age level. In the first type, the infant thrusts one knee forward beside the trunk, the leg being flexed abductively, and the dorsum of the foot contacting the supporting surface. The second type of behavior is much the same except that the attitude of the foot has a plantigrade suggestion, the foot being everted so that the inner side of the foot presses against the supporting surface. Whereas in the first type there is a dorsal drag which hints a relative weakness in the dorsi-flexion which later produces the plantigrade foot position seen in plantigrade progression, in the second type of behavior the foot position is definitely suggestive of the plantigrade progression which is likely to follow in five months' time.

Although nearly all infants exhibit both of these types of behavior, the majority of them predominantly and characteristically exhibit one

*Accepted for publication by Arnold Gesell of the Editorial Board, and received in the Editorial Office on December 1, 1938.

type or the other In the present study we have attempted to determine whether or not the predominance of the second type of behavior, that is, eversion of the foot in a manner which suggests stepping, actually foretells plantigrade progression. If this is the case, do infants who do not exhibit such precursory plantigrade behavior also fail at a later age to progress on hands and feet? The following illustrations (Figure 1) define the two types of early foot behavior

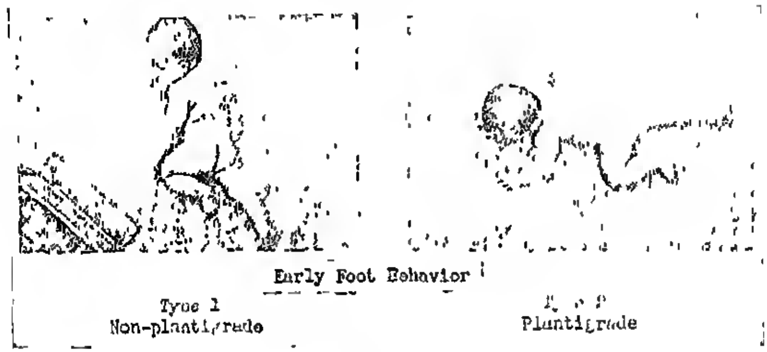

FIGURE 1

B Experimental

At the beginning of this study, cinema and written records were available on the prone behavior of 14 infants These data included monthly, and in many cases bi-weekly, records of the prone behavior of each infant covering the period from 8 to 52 weeks and in some instances a longer period Quantitative analysis was made of the cinema records to determine the predominance of Type 1 or Type 2 behavior in each case. This determination was made by counting frames In cases where only written records were available, determination was made by inference. As to plantigrade progression, determination was by inspection, quantitative analysis not being necessary.

Since analysis of this original group of cases involved backward prediction only, all data being immediately at hand, a supplementary group of 10 six months' old infants was added that we might put prediction to actual test. These infants were visited in their homes. As soon as they exhibited Type 1 or Type 2 behavior, a written record of all foot movements during a 15-minute interval

was taken. Since forward foot thrusts were usually too brief to be measured with a stop watch, the number of times that each foot moved forward in either position was recorded. These 15-minute observations were repeated until there was no question as to which type of behavior dominated. Records included the behavior of both feet. In the one instance where there was a discrepancy, behavior of the more active foot was considered. These infants were revisited at intervals until they were 15 months old or until they had exhibited plantigrade progression.

When all the data had been gathered, the early behavior of each subject was classified as *non-plantigrade (Type 1)* or *plantigrade (Type 2)*, or if neither type prevailed, as *ambivalent*. Later behavior was classified as *non-plantigrade, plantigrade progression,* or *plantigrade stance* only.

C. RESULTS

Table 1 indicates the degree of correspondence between early and late behavior. If early behavior predicts later behavior, children whose early foot posture has a definite plantigrade suggestion will at a later age progress on all fours (palms and soles). Conversely, children whose early behavior is non-plantigrade would not be expected later to progress on all fours, though they might conceivably attain the all fours position. Likewise, children whose early behavior is "ambivalent" might be expected later to show no plantigrade behavior or at most mere assumption of the plantigrade stance without actual progression on all fours.

TABLE 1

Early behavior	Later behavior	No. of cases
Non-Plantigrade	No plantigrade	4
Non-Plantigrade	Plantigrade stance only	2
Ambivalent	No plantigrade	4
Ambivalent	Plantigrade stance only	1
Plantigrade	Plantigrade progression	12

The combinations of categories in this table are all in accordance with what we should expect in case early prone behavior is definitely predictive of later behavior. It will be seen that 23 out of the 24 cases in the present study fall in one or the other of these combined categories.

As the table indicates, 12 children who at six months exhibited a

plantigrade type of foot behavior, later crept on palms and soles. It is in accordance with the theory (1, p. 454) that plantigrade progression is one of a series of prone behavior stages common to many normal infants, that the largest number of cases should fall in this category.

Of the six children who at six months exhibited no plantigrade behavior, four showed no plantigrade behavior at one year, two assumed the plantigrade stance. Of the five who at six months were in the ambivalent category, four showed no plantigrade behavior at one year, one assumed the plantigrade stance.

In only one of the 24 cases did early behavior prove non-predictive of later behavior. This was the case of a girl who at six months showed markedly plantigrade behavior. She later attained the plantigrade stance, but walked at 11 months and was not seen to progress in plantigrade fashion. Early behavior had indicated that plantigrade progression would probably be observed.

D. Conclusions

It appears that definite precursor signs of plantigrade progression may be observed in the human infant. If early (about 28 weeks) foot behavior characteristically has a definite plantigrade suggestion, that is, if the inner side of one foot presses against the supporting surface in what approaches a stepping position when the knee is thrust forward beside the trunk, plantigrade progression will probably be exhibited later. Predominance of that type of behavior in which the dorsum of the foot contacts the supporting surface when the knee thrusts forward, suggests a relative weakness in dorsi-flexion and indicates that plantigrade progression will probably not be exhibited later. Predominance of neither one nor the other, also indicates that plantigrade progression will probably not be exhibited, although the plantigrade stance may be assumed.

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The Journal of Genetic Psychology, 1939, 55, 443-446

RELATIVE JUDGMENT IN PUPIL ABILITY RATINGS*

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Since the beginning of the testing movement for intelligence there has been considerable conjecture concerning the accuracy with which teachers are able to judge the relative native ability of a group of pupils The assumption has too often been made that if a teacher has taught a group of pupils for some time, he will be able to place each pupil on a scale from high to low native ability with a large degree of accuracy Those who have worked with tests of native ability have sensed in some degree the inaccuracy of judgment drawn from an acquaintance of a pupil in one or two classes

It is quite probable that a teacher's judgment concerning a pupil's native ability is largely derived from the pupil's accomplishment in that teacher's class. However, there seems to be a surprising difference between pupil-accomplishment as rewarded through the grading procedure now followed by teachers and the actual native ability of pupils as shown by a standardized test of native ability (1).

The question considered in this discussion is not concerned with any particular method of ranking pupils for intelligence, but with the accuracy obtained when teachers are allowed to determine the relative intelligence of members of a group by any method they may devise Under ordinary conditions are teachers able to obtain a high degree of accuracy when an attempt is made to place each pupil of a group on a scale from high to low according to his position in relation to every other pupil in that group?

The objectives of this study were: (*a*) To determine the degree of accuracy with which teachers are able to place pupils on a comparative scale of intelligence, (*b*) to compare the ratings of different teachers with each other, (*c*) to compare the average of five teachers' ratings with each teacher's individual rating, and (*d*) to compare the average of the five ratings with a test of native ability

The study was begun by submitting a list of 92 pupils to five teachers for the purpose of having the teachers rate the pupils The

*Received in the Editorial Office on December 12, 1938

names on the list included all the pupils in a small high school Most of the pupils listed were in one or more classes of each teacher to whom the list was submitted The instructions included in the lists were: (*a*) That the teacher should rank the pupils according to the teacher's estimate of each pupil's native ability as compared with the intelligence of each other member on the list, and (*b*) that any method of determining the rank of the pupil might be used which in the teacher's judgment would give the most accurate results The teachers were further informed that no pupil should be ranked who was not in at least one of the teacher's classes and that any pupil's name might be omitted from the list if the teacher considered that he could not properly place the pupil

The instructions doubtless account for the great differences in the number of pupils ranked by the different teachers

Subsequent to the return of all the lists with the complete rankings on them the Otis *Group Intelligence Scale, Advanced Examination, Form A,* was administered to each pupil whose name appeared on the original list and from this examination the *IQ*'s of the pupils were determined. These results were then paired with each teacher's ranking and the coefficient of correlation determined for each group. The relative position of a pupil on one list was paired with the relative position on another list and these pairs correlated. The position of a pupil as given on one list was paired with his average on all five lists and these were correlated The average of each pupil on the five lists was also paired with his rank as determined by the Otis *Group Intelligence Scale.*

There had been no previous tests of mental ability made available to this group of teachers and no teacher had access to the permanent records of the school. This made the only material available to each teacher that of his own grades and such devices as he might construct individually

Teachers were informed that the results of their ranked lists were to be used for a study They were asked to work independently of each other, and were requested not to discuss the position of pupils as listed by them with the listing of other teachers. The size of the coefficients of correlation between teacher's ratings suggest that the teachers carried out these instructions very definitely. The verification in the dates on which the lists were received from different teachers indicates that no two teachers were working together.

The total number of pupils listed for teachers to rank was 92

TABLE 1

THE PUPILS RATED BY FIVE DIFFERENT TEACHERS COMPARED WITH THE INTELLIGENCE QUOTIENT OF THE PUPILS RATED, THE AVERAGE OF THE FIVE DIFFERENT RATINGS COMPARED WITH THE INTELLIGENCE OF THE PUPILS, THE AVERAGE OF THE FIVE DIFFERENT RATINGS COMPARED WITH EACH INDIVIDUAL RATING, AND THE INDIVIDUAL RATING OF EACH TEACHER COMPARED WITH THE INDIVIDUAL RATING OF EVERY OTHER TEACHER

Classifications	Teacher's number 1			2			3			4			5			Average		
	N	r	E_m	N	r	E_m	N	r	E_m	N	r	E_m	N	r	E_m	N	r	E_m
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Teacher No 2	54	49	13															
Teacher No 3	76	54	15	47	56	17												
Teacher No 4	71	37	07	50	49	13	66	61	21									
Teacher No 5	80	42	09	51	47	12	73	64	23	67	48	12						
Average all teachers	83	81	41	53	76	35	76	75	34	70	90	56	81	77	36			
Intelligence Quotient	84	59	19	53	58	18	76	67	26	69	28	13	80	49	13	83	74	33

The number each teacher ranked is shown in Table 1 It may be seen from the number of pairs correlated that one teacher ranked only a little over 50 per cent of the pupils on his list The greatest number of pupils on any list which was ranked amounted to a little over 91 per cent of the entire list. The data show that the final rankings used in this study were based in part upon a selective group.

Summary of Findings

The average of the five teachers' ratings has a much higher correlation with intelligence than it has with the rating of an individual teacher The correlation between the average of the ratings and intelligence is 74 The range of coefficients for the five teachers taken separately is from 49 to 64. There is a higher correlation between each teacher's rating and the average for the five ratings than there is between the average for the five ratings and intelligence; between intelligence and each teacher's rating; or between one teacher's rating and any other teacher's rating The least relation is found between the rating of one teacher with the rating of any individual teacher's rating

Conclusions

According to the findings, the nearest approach to the accuracy of a test of native ability for determining the intelligence of a pupil is the average of several teacher's ratings This reliability is far too low to be substituted as a basis for judging native ability separately from an intelligence test. The better tests of native ability have a reliability of about 95 Such a test would have a coefficient of dependability of 69 The coefficient of correlation between intelligence and the average of several teacher's ratings is only 74. The coefficient of dependability is only .33 for such a correlation. Thus the coefficient of dependability for intelligence and the average of several teacher's ratings is less than one-half as great as the coefficient of dependability should be for tests having high reliability.

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Gill Public Schools
Gill, Colorado

The Journal of Genetic Psychology, 1939, 55, 447

TWELFTH INTERNATIONAL CONGRESS OF PSYCHOLOGY

GODFREY THOMSON, *General Secretary*

The Twelfth International Congress of Psychology will be held in Edinburgh, Scotland, from 22nd July to 27th July, 1940

The Congress fee has been fixed at thirty shillings (£1 10s) sterling for active members and fifteen shillings (15s) sterling for associates

Arrangements are being made by which a large proportion of the members can be accommodated in University hostels The inclusive charge for such accommodation will be about fifty shillings (£2 10s), excluding midday lunches, arrangements for which will be made elsewhere Members who do not desire accommodation in the hostels can easily secure accommodation in hotels and private hotels, of which Edinburgh has a large number

When the Committee of Organization is fully constituted, formal invitations will be issued It will, however, greatly facilitate arrangements if as many as possible will let the General Secretary know now that their attendance at the Congress is probable In the meantime subjects for symposia, general discussion and lectures are under consideration by a Preliminary Arrangements Committee

A volume of Proceedings of the Congress, containing abstracts of papers read, will be published, the cost of which is included in the Congress fee for active members.

JAMES DREVER
President of Committee of Organization

GODFREY THOMSON,
General Secretary
(*Moray House, Edinburgh 8*)

APPARATUS

The Journal of Genetic Psychology, 1939, 55, 449-451

A SERIES OF TAPE-PRINTING BOARDS*

Cambridge, Massachusetts

MARIE L. H. FORBES

The apparatus described in the following is an attempt to adapt to tape-printing some of the traditional materials of infant schools from the historic horn-book or "criss-cross-row" to the sensory materials of Froebel, Seguin, and Montessori. It consists of a board with numerically grouped holes and loose pegs, and a series of seven printing boards each equipped with ready-inked blocks, fixed printing frame, and gummed tape.

The device has been designed with economy to serve under-privileged children in crowded institutions and isolated rural homes. The specifications include a plain basswood carrying case, not much larger than that of a portable typewriter, which when open has the appearance of a cupboard, with cleats on which the boards slide in and out, the complete outfit weighing about 10 pounds.

The printing boards are provided with sticks or blocks as follows: (1) geometric sticks, (2) color sticks, (3) blocks with colored geometric labels, (4) blocks labelled with cross and geometric outlines, (5) blocks labelled with domino and digit on adjacent sides, (6) blocks with Gothic alphabet, (7) blocks with Roman alphabet, capital and small letters on adjacent sides.

When in use the printing board is clamped securely to the table in the left-hand corner, the child being allowed to use both hands at the same time. The mechanical operation is the same whether the child is matching by superimposing or by copying. In the former operation tape is used, the tape having been marked off in sections the width of a block, every other section stamped; in the latter,

*Received in the Editorial Office on September 8, 1938.

index cards, stamped with a single item or a row of items. In the former with printed tape in the printing frame, the child (*a*) looks in the frame, (*b*) selects the required block, (*c*) places the block in the frame, (*d*) returns the block to the tray and (*e*) pulling the tape, "spaces." In the latter, with felt under the blocks inked, with white tape in the printing frame, with a stamped index card displayed as a model, the child (*a*) looks at the model card and repeats from "*b*" above.

The writer gratefully acknowledges the examination of the materials by Dr. Walter F. Dearborn, Director of the Psycho-Educational Clinic, Harvard University.

General Specifications

Peg board. The peg board which hangs folded on the inside of the right-hand door of the carrying case consists of two boards 11⅛ in. x 5 in. x ¼ in. hinged end to end, with a total of twenty-one holes 33/64 in. D. The holes are in groups of one to six in domino patterns, the centers of the four-hole group forming a 1½ in. square. If the center of each hole is represented by a digit, the patterns are as follows:

5 2-8 2-5-8 1-3-7-9 1-3-5-7-9 1-3-4-6-7-9

Printing boards. The printing boards consist of seven boards 11⅛ in. x 5 in. x ¼ in. to two of which are hinged extensions 11⅛ in. x 2 in. x ¼ in. which are folded upward when the doors of the carrying case are closed.

Frames. A pair of frames, ends 15/16 in. x ½ in. x ¼ in., sides 1 9/16 in. x 7/16 in. x ⅛ in., is attached to each of the seven boards in the lower left corner, a margin of ¼ in. at the left. In the frame at the right is placed a 1 yd. roll of white gummed paper tape, 1 in. wide.

Sticks and blocks. The printing sticks are 1 in. high, eleven with round bases ¾ in. D., one with square base 11/16 in. on the side, one with base in the form of an equilateral triangle, ¾ in. on the side. Pegs, 1 in. x ½ in. D.

The rectangular blocks, of white basswood or white pine, 1 in. long and ¼ in. high, are in two widths, A ⅞ in., B ¼ in. After the tops of the blocks have been stamped in ink, the blocks are given one coat of white shellac.

Trays. Floors and sides of trays are cut from basswood ⅛ in. thick, floors from a strip 1 1/16 in. wide, sides from a strip ¾ in. wide, in the following lengths: A 11⅛ in. (seven trays), B 10 3/16 in. (one tray), C 6¾ in. (one tray), D 5¼ in. (two trays).

Six open trays (length A) have a central partition and four cross-pegs on each side of the partition. One covered tray (length A) has nine partitions but no cross-pegs. One open tray (length B) has two partitions dividing it into three equal sections, two cross-pegs in each section.

Ends and partitions in open trays (twenty-six pieces) 1 1/16 in. x ⅝ in. x ¼ in.; in covered trays (thirteen pieces) 1 1/16 in. x ½ in. x ¼ in.; cross-pegs (sixty-three) 1 5/16 in. x ⅛ in.; holes for cross-pegs ⅛ in. D.

Covers. Two trays, lengths A and D, have covers of three-ply wood 1 1/16 in. wide and ⅛ in. thick with holes for printing sticks. Printing

frames used with the printing sticks have covers 1 9/16 in. x 1 1/16 in. with holes of the same dimensions. The cover used with the color sticks has a margin of ⅛ in. at each end and ten equidistant holes 13/16 in. D. The cover used with the geometric sticks has a margin of ⅛ in. at each end and three equidistant holes, a circle 13/16 in. D (drilled), a square ¾ in. on the side, an equilateral triangle 13/16 in. on the side, cut with a jig-saw.

Carrying case. The carrying case is made from a basswood board 6 in. wide, ⅜ in. thick, as follows: Top, floor, two upright sides, four boards, 12 in. long; two-door front, two-piece back, four boards, 12¾ in. long.

The cleats are 5 in. x 3/16 in. x 3/16 in. The tops of the cleats are 1⅝ in., 3⅛ in., 4 9/16 in., 6 in., 7 7/16 in., and 9 11/16 in. from the ceiling of the case.

The doors, which have 1 in. brass hinges, are fastened with 1 in. flat brass hooks. A handle is screwed to the top of the case.

Printing Boards, Assembled

1. Three geometric printing sticks, rubber bases, covered tray with geometric holes, length D, 1 pr. frames, detachable covers for printing frame, to be used with or without ink.

2. Ten cylindrical sticks, rubber bases, tops colored red, orange, yellow, green, blue, violet, white, grey, black, brown, covered tray with ten circular holes, length A, 1 pr. frames, stationary cover for printing frame, to be used with colored inks or without ink.

3. Nine blocks, A width, stamped with their own dies, ½ in. circle, ½ in. square, 9/16 in. equilateral triangle, solid figures, red, blue, green, blocks grouped according to color, tray, length B, 1 pr. frames, red, blue, green ink.

4. Five blocks, A width, stamped with their own dies, cross of ½ in. vertical and horizontal lines, and, in outline, ½ in. circle, ½ in. square, 9/16 in. equilateral triangle, diamond ½ in. on the side; tray, length D, 1 pr. frames.

5. Six blocks, B width, stamped with their own dies, dots 3/16 in. D patterned after the peg board, above, and digits ⅝ in. high, in such a manner that when the dot is on top of the block the digit is on the right side, tray, length C, 1 pr. frames.

6. Twenty-six blocks, A width, stamped with their own dies, condensed Gothic, solid black line, 11/16 in. high, the first tray, aligned with the back of the board, raised on blocks ¾ in. high, the second on blocks ⅛ in. high, the third, for possible future use with a sheet of paper, on pieces of card-board, trays placed ¼ in. apart, blocks in alphabetical order beginning at the left of the first tray, 1 pr. frames attached to extension, stationary unstamped blocks in last four compartments of third tray.

7. Twenty-six blocks, B width, stamped with their own dies, condensed Roman ⅝ in. high, in such a manner that when the small letter is on top of the block the capital is on the right side, four unstamped blocks, blocks in alphabetical order, trays, extension and frames as above, board No. 6.

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The Journal of Genetic Psychology, 1939, 55, 453-462

BOOKS

The *Journal of Genetic Psychology*, the *Journal of General Psychology*, and the *Journal of Social Psychology*, will buy competent reviews at not less than $2 per printed page and not more than $3 per printed page

Conditions Only those books that are listed below in this section are eligible for such reviews In general, any book so listed contains one or more of the following traits (*a*) Makes an important theoretical contribution, (*b*) consists largely of original experimental research, (*c*) has a creative or revolutionary influence in some special field or the entire field of psychology, (*d*) presents important techniques

The books are listed approximately in order of receipt, and cover a period of not more than three years A reviewer must possess the Ph D. degree or its equal in training and experience

Procedure. If among the books listed below there is one that seems important to you, you are invited to write a review of that book It is not necessary to make arrangements with the Editor Just send in your review It does not matter if the book in question has been reviewed before.

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CRITICAL REVIEWS OF RECENT BOOKS

(*Buhler, Charlotte The Child and his Family Translated by Henry Beaumont. New York Harper, 1939 Pp 187*)

REVIEWED BY WALTER L WILKINS

Published in Germany in 1937 under the title *Kind und Familie*, this study concerns itself with parent-child and sibling relations occurring within the ordinary family circle Twelve psychologists trained in observational techniques visited 17 families and studied 30 children They visited twice weekly during periods ranging from three to six months The families were upper middle class, having one to three children, with the children generally of school age

Dr Buhler carefully disclaims any great general validity for the conclusions reached as a result of the study of these children and their relations to their parents and to each other. She hopes that the chief contribution of the study will be to the techniques of studying children genetically within the most important group in social living, the normal familial milieu.

Parent-child relations were studied intensively in six families, each of which exemplified a different sort of social situation. In one the child formed the center of family interest as a child, and in this family affection was the chief motive in the family life. In another the child formed the center of family interest as an educational object. As in the first, the child controlled almost completely the parents' interests In a third the unity of the family was the primary concern to the parents, and the child was part of a harmonious unit. In a fourth, the household and its duties regulated the social situation and the children were cogs in the management of household affairs In a fifth the struggle for existence dominated family interests and the child was expected to contribute all he could to the economic welfare of the adults.

The description of each of these different sorts of family milieu is achieved in a quantitative way The observers, who came to know the families so intimately that they were accepted without reservations, noted social life in terms of contacts between the persons in the family These observations were in terms of *activities*, and

Buhler's insistence on the unitary character of the activities observed is stoutly defended. She rejects as not only impossible, but also meaningless, any attempt to make observations on school-age children in terms of reflexes or any other physiological units.

The inventory of the child's life situations was classified sixfold. "Social intercourse, play activities, biological situations (eating, dressing, bathing), school and school work, domestic activities, and situations in the outside world (outside of home or school)."

> Social situations offer an opportunity for contacts which are ends in themselves, give the child the experience of belonging to the family unit, and develop his position as a full-fledged member of this social structure. In play, biological, and school situations, the child and his activities are the center, but not in the same manner. In play situations, the emphasis is on the child's free development, while in biological situations he is the object of care and help, and in school situations pedagogical points of view prevail to bring about the desired responses in him. The household situation, on the other hand, is primarily an adult domain, in which the child is occasionally made a partner who has to assist, adjust himself, etc. In this situation, the child has to accept the interests and occupations of the adults. Finally the outside world presents a neutral situation in which any kind of contact may be established. Specifically, it provides the child's introduction to nature and life in general, in the form of conversations and instructions (pp. 44-45).

Purposes of social contacts in family life were inventoried as follows:

> *Social.* Affection, social intercourse, conversation; unfriendliness.
>
> *Pedagogical.* On the part of the adult: Instruction, guidance, consideration of the child. On the part of the child: Objective questions and statements, seeking permission or recognition, criticizing and influencing the adult.
>
> *Organizational.* Arranging social relations.
>
> *Charitable.* Giving, offering help, desiring, demanding help.
>
> *Economic.* Taking care of things; claiming property rights, destroying things.

Analysis of the statements accompanying actions or activities revealed the purposes well enough for the study's aims. Sibling rela-

tions were characterized by the attitudes they expressed and parent-child relations by their overt purposes. Justification of the classification of overt purposes is made by Dr. Buhler.

> In the long run, social psychology and the study of social conduct become impossible if the purposes and attitudes expressed in human relations continue to be ignored, since they constitute the most essential elements. Furthermore, it is relatively useless to determine how often one child establishes contact with another, without stating whether this was done with friendly or unfriendly intentions, for the purpose of taking something away from him or giving him something, attacking or defending oneself, etc. Every effort should be made to make possible a reliable study of such elements as can be grasped only by interpretation.
>
> In view of the extraordinary precision with which we react in every-day life to the intended purposes of other persons, it seems quite indefensible that psychology should ignore the study of these phenomena. Adult psychologists should be able to discover criteria for recognizing the child's purposes as expressed in his behavior, since, as Adela Poznanska has shown in a Viennese study, an eight months' old child can recognize different play intentions in his mother's facial expressions and gestures, and, as Hildegard Hetzer found in a second study, understands quite well whether his mother makes an angry face playfully or in earnest; since a kindergarten child feels and shows in his reactions that he understands whether someone approaches him with real affection or with affectation, and since a school age child understands and shows in her reactions that she knows whether her mother makes her dry the dishes and clear the table for pedagogical reasons, or because she herself happens to be seated comfortably.

Analysis of the contact situation in parent-child relations for the group studied showed that parent-initiated contacts are likely to be concerned with biological and social activities, while child-initiated activities are more likely to be concerned, in addition to social, with outside world and play activities. In terms of the purposes of parent-child contacts, the parent-initiated contacts are likely to be pedagogical (guidance, chiefly), whereas the child-initiated contacts are likely to be social (chiefly social intercourse).

The rôle which adults play in sibling relations is stressed in this study. Adult interference in sibling relations is most frequent when

sibling relations are antagonistic, and mothers were eight times more frequent in interfering in sibling relations than fathers.

Some of the conclusions which Dr. Buhler puts forward for other investigators to follow up and check include:

> (*a*) "Although the child as a member of a group can be induced to participate in a joint objective activity, he does not usually have the desire to organize spontaneously with other children in order to perform some objective task. This type of behavior was not found before puberty, at the age of 14 or 15." [Progressive educators note!] (*b*) Cooperation and opposition together accounted for about 20 per cent of all sibling contacts (*c*) The child's personal attitudes are expressed more manifestly and clearly in his contacts with other children than in his relations with adults (*d*) "A sibling relation which is very objective and contains few expressions of attitude is not childlike, but precocious, strained and somehow wrong." (*e*) "Dominance appeared to be based on factual superior ability of the sibling who was older, more mature, or more skillful, or who otherwise appeared to be better equipped by nature for this position, rather than on indirect conditions such as differences in social position or other secondary advantages This agrees with the previously observed fact that children have a clear conception of their own personal importance and seldom deceive themselves in this respect" (*f*) (From an appendix, "The problem of obedience" by Sophie Gedeon.) "Evidently, lenient treatment was much more effective in the case of the boys than was strict treatment, whereas there was little difference in the case of the girls. Strict treatment was more effective in the case of girls than of boys." For this two explanations are offered boys resent strict treatment more than do girls, or are more persistent in resistance than are girls.

The chief contribution of the present volume is methodological, but as the six points above indicate, there are plenty of suggestions for further study and many tentative conclusions about unexplored areas of children's social development. The volume shows how the typically American technique of careful observation of children's contacts can be adapted to the study of the most primary of groups. The conclusions for child psychology are tentative, but the success of the technique should provoke studies to check Buhler's hypotheses and many other of the tentative conclusions concerning the social psychology of familial life

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